THE

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PETROL MOTOR-'BUSES v. TRAINS AND ELECTRIC TRAMWAYS.

IN view of the numerous statements which have recently been made in the daily Press, that petrol 'buses are the means of rapid transit of the future, and that the electric tramcar is doomed, we think that it is only right that a little more light should be thrown on this important subject, and that the advantages and disadvantages of petrol 'buses and electric tramcars should be clearly understood by the public. From the correspondence and articles which have recently appeared in the various motor papers and in the daily Press, it is evident that there exist very serious misconceptions in the minds of a great many people. The mere fact that petrol omnibuses can attain high speeds, carry large numbers of passengers, and earn large receipts, and that in some cases it takes a shorter time to get from one part of London to another by such omnibuses than by electric tramcar, does not by any means prove that the latter is doomed. Neither does the fact that 'buses can be satisfactorily operated by petrol motors, and, under certain conditions, give good financial results, prove that the petrol engine is suitable to operate tramcars under conditions of heavy service, such as are met with in our large towns, in which electric tramways are being successfully operated. The misconception which exists in the minds of many is well represented by a report which has been recently made to the chairman of the Highways Committee by Dr. Mansfield Robinson, the town clerk of the Borough of Shoreditch. We take this opportunity to thank Dr. Mansfield Robinson for his courtesy in allowing us to have a copy of his report, and trust that he will forgive the criticisms which we feel compelled to make.

The first serious error into which Dr. Mansfield Robinson has fallen, is to suggest the possibility of utilising, for mechanically operated cars, the existing lines originally laid for the use of horse cars. Experience has clearly demonstrated that this is impracticable, as an old track which has originally been laid only for horse traction, with its short points and crossings and badly-designed rails, will not stand for any period the jars to which it is subjected by heavy motor-cars, be they of the electric, steam, or other type. Any such attempt would only result in reconstruction a few months after mechanical traction had been adopted. Furthermore, points and crossings which might be satisfactory for horse traction, become quite impracticable with motor-driven cars. This was clearly shown in the case of Perth, where the Corporation had adopted a petrol tramcar to be operated on its existing horse tramway lines, which were laid only a few years ago. The results were most unsatisfactory, as the car was constantly getting derailed on curves and at points and crossings. Incidentally, it may also be mentioned that the petrol motor coach itself was far from satisfactory. The outcome of this experiment was the reconstruction of the tramways, which are now going to be worked electrically.

When the town clerk of Shoreditch begins to discuss the cost of electric traction, we must certainly say that we agree with him in condemning the conduit, as we feel very strongly that there was no necessity for the County Council to waste the large amount of money which it has expended in putting down the conduit system in streets where there exists no reason for not putting up overhead construction, and therefore we need not discuss the figures as regards conduit construction.

In comparing petrol and electric cars, where both run on rails, since it is absolutely necessary to reconstruct the track, and to lay it in exactly the same way in both cases, the cost of this part of the system need not be considered.

The only difference between electricity and petrol as regards the cost of street construction, lies in the overhead work and track bonding, which can be put down at £1,000 per mile of route, so that the difference between the cost of construction of an electric and a petrol tramway 56 miles in length, which is the distance Dr. Mansfield Robinson is considering in the case of the North Metropolitan tramways, would be £56,000, and not as he states, £448,000. This difference, however, is more than counterbalanced by the very much greater cost of a petrol car as compared with an electric car. Thus, while an electric car can be purchased for, say, £600 complete, petrol cars of the same capacity, and built to run at the same schedule speed, would cost at least three times as much, which, on the 600 cars that Dr. Robinson considers, would amount to a sum of £720,000 in favour of electricity as compared with petrol.

As regards the capital cost of a power station, it is unnecessary to go into this, because, with the load factors obtainable with electric traction it is an acknowledged fact that energy can be delivered to the trolley line at a cost considerably less than 1d. per unit, this cost including not only works cost and cost of maintenance, but also depreciation, sinking fund, and interest on capital for the power station, substations and feeders, or, in other words, on the complete plant required to generate and distribute electrical energy to the trolley wire.

As regards operating expenses, then, particularly in connection with the cost of power, electricity can be supplied to the cars at a cost not exceeding 1d. per Board of Trade unit, which, under ordinary conditions, is practically equivalent to a cost of energy of 1d. per car-mile. Data which we have recently been able to obtain, from a source upon the accuracy of which we can absolutely rely, show that for tramcars operated by petrol motors, and having a seating capacity equal to that of electric cars, and built to operate at the same schedule speed, the petrol consumed amounts to 1 gallon for every 5 to 6 miles, according to circumstances, which works out for motive power alone at considerably over 1d. per car-mile. In this connection, it must be borne in mind that whereas with electric traction the lighting of the cars is included in the cost of motive power, this is not the case with petrol cars, and therefore allowance would have to be made for this, which would increase the cost for petrol cars. The fact that some motor-omnibuses on rubber tires have been run, has impressed the public with the idea that tramcars could also be operated and give good results; but the fact that tramcars run on rigid rails, and not on rubber tires, and that they therefore have to be of much heavier construction than 'buses, and the fact that rapid acceleration is absolutely essential, necessitate the motive power on a tramcar being far in excess of that required for motor-omnibuses. Our contemporary, the *Engineer*, in an article published on February 3rd, states that a 90-H.P. engine would be required for a petrol tramcar, in order to obtain the same results.

The experience gained with electric traction has been exactly the same. Twenty or twenty-five years ago, electric cars used to have 5-H.P. motors; 10 years ago 25-H.P. motors were considered ample, whereas, at the present time, 35-H.P. motors are being used.

It must not be forgotten that electric motors are capable of giving out at least double their rated capacity for short periods; thus, on a modern electric tramcar the equipment is capable of giving out 150 H.P. This is not the case with a petrol 'bus, and, therefore, if at any time 100 H.P. should be required, no matter for how short a period, the petrol engine would have to possess a capacity equal to this maximum demand. In other words, the normal capacity of the petrol motors has to be sufficient to handle the maximum load, or equal to at least double the rated capacity of an electric motor.

The petrol motor of the present day, although simple when compared with the petrol motors with two or three years ago, is, all the same, a complicated machine when compared with an electric motor; to keep it in good order and look after it requires expert mechanics, such as are met with on railways, but not such as are usually found on tramway installations.

The cost of maintenance of the petrol motor equipment, owing to the large number of moving parts, is much greater than the cost of maintenance of an electric equipment, and the vibration, due to the high-speed reciprocating engine, will also increase the maintenance of petrol car bodies. The petrol motor has a further disadvantage, that it is not self-starting, and even if it were it would never start under load.

As regards the reliability of these machines, provided they are properly looked after and kept clean, they will work satisfactorily, but any failure in lubrication may cause trouble, and result in some of the cylinders not working, with the result that the engine loses power and is incapable of a proper fulfilment of its duties.

In order to keep down the first cost, high speed petrol engines are generally used, and this runs up the cost of maintenance. Further, the engines must be kept running all the time, whether the car is moving or standing still, and the vibration of the high speed reciprocating engines is particularly noticeable and objectionable when the car is stopping to put down or pick up passengers.

Even under the most favourable conditions, a petrol car gives off a certain amount of smell, which cannot be called exactly pleasant. Again, as regards the question of danger, although there is not much to fear with a petrol coach in the ordinary way, yet if there is a leak in the petrol tank, and if, through the carelessness of workmen, a lighted match or cigarette comes in the neighbourhood of such a leak, a fire is sure to follow, and the whole machine is consumed, as it is practically hopeless to try to save it, owing to the combustible nature of the materials of which it is constructed. The accidents to the Great Western 'buses, which were burnt up, and to several other 'buses, of which we have read in the daily Press, prove that such occurrences are not merely imaginary.

As regards the question of motor-'buses ever competing with electric tramways, it is possible that in those districts where the traffic is light and the distances are comparatively great, so that the headway between the cars is large, motor-'buses may give good results, and we believe that the Great Western Railway Co. has found this to be the case. But where the traffic is dense we do not consider that motor-omnibuses will ever successfully compete with electric tramways.

The cost of tires for motor-omnibuses is a serious matter, this item, as we know from figures which have been submitted to us, and which we know to be reliable, amounting to as much as 3½d. to 4d. per car-mile. To this must be added the cost of petrol, the cost of maintenance and repairs and the general running expenses.

Turning again to Dr. Mansfield Robinson's report, it is quite correct that there are petrol motor-coaches running on the Great Northern Railway, and, as a matter of fact, the Brighton Railway Co., following the advice of its consulting electrical engineer, Mr. Philip Dawson, has decided to adopt petrol motor-coaches on some of its branch lines; whereas in London, as our readers are probably aware, the same company, following the same engineer's advice, is going to adopt electric traction on the lines on which it gets the densest traffic. But in this connection, it must not be forgotten that, in the case of a railway, the conditions for petrol are more favourable than in the case of a tramway, as the whole equipment can be put under the body of the car, thus leaving a clear space available for passengers and luggage. In the case of a tramcar this would not be possible. Furthermore, in the case of railways which employ petrol motor-coaches, if they are used on branch lines where stations are far apart, rapid acceleration is of no great importance. In tramway work, the conditions are exactly the reverse. It is quite true that many of our London omnibus companies contemplate adopting motor-'buses wholesale, but we believe that we are correct in stating that none of them, as yet, have got any reliable experience as to what the cost of the up-keep and running, not to speak of the maintenance and depreciation, is going to be. We believe that the cost of operating petrol 'buses will certainly not fall far short of 1s. per car-mile, and may be considerably more; and if this is proved to be the case, this fact alone will be quite sufficient to prevent motor-omnibuses ever being serious competitors to electric tramcars operating in densely populated districts.

THE TELEPHONE SETTLEMENT.

To those who are familiar with the course of telephonic affairs in this country—even to those who but vaguely recall the numerous controversies which, at recurring intervals, have been aroused—it may seem to be suggestive of undue confidence to write about the telephone question as settled. Yet it seems so unreasonable to anticipate that any serious objection can be found to the agreement between the Postmaster-General and the National Telephone Co., which Lord Stanley laid upon the table of the House of Commons last week, that we are bound to look upon the question as practically settled. Should the present session pursue its normal course, the agreement will be submitted to the House and to a Select Committee. The principle of the agreement in the main has already met with the approval of Parliament, and its ratification is, we think, a foregone conclusion. But in the event of the session being interrupted, or the time of the House being entirely taken up with the efforts of the leaders to obtain a clear expression of each other's opinions on fiscal problems, the agreement will come into automatic operation on August 31st—a provision which may be useful, and which, under the circumstances, seems to be wise.

The agreement provides for taking over the whole of the company's plant in 1911 on the terms which were agreed upon for the London plant in 1901. The company will be paid the fair market value of the plant at the date of transfer, due regard being had to the nature and then condition of such plant, to its state of repair, and to the circumstance that it is in such a position as to be ready for immediate working, and to its suitability for the purposes of the Postmaster-General's telephonic service. There are two features that have to be met in the new agreement, which did not require attention in the London agreement: — The private line business, and the prolongation of the licence in certain areas through the operation of Mr. Hanbury's Act. The intention of the agreement is, that after 1911 the National Co. should cease to carry on business. The private line business is independent of Post Office control so long as the lines connect premises in the same ownership, but the lines, though not connected to switchboards for the purposes of intercommunication, become in an increasing degree part of the general system, and it is probable that they are, in many cases, terminated on the premises of the company for the purpose of efficient test and control. It is, therefore, convenient and desirable that the Post Office should acquire these lines, but as there is no obligation to sell, and a goodwill has been created, an amount equal to the profits of the last three years is to be paid. The licences which have been prolonged are those in which municipal competition has been started—Glasgow (2 years), Portsmouth (14½ years), Swansea (9 years), Brighton (14¼ years). The land, buildings and plant in these exchanges will be surrendered on the terms above referred to, but the value of the unexpired licences will be agreed between the Postmaster-General and the company, "regard being had to the net profits of such business, and to the circumstances and conditions under which the company would carry on such business after December 31st, 1911." Failing agreement, arbitration is available. The important feature in this arrangement is the recognition of the desirability of uniform management. All business is to be transferred at 1911. If there is any value in the surrendered licence, compensation in proportion will be given, but there is, very properly, no idea of the company continuing to work those licences until their expiry.

The important question of payment for the property acquired is dealt with in Clause 7, which provides that the Postmaster-General shall have the option of paying three-fourths of the purchase money in terminable annuities running over a period not exceeding 20 years, such annuities being calculated so as to pay the whole of the purchase money by the end of the period fixed, with interest on the balance outstanding from time to time at the rate of 3 per cent. per annum. The payment of the remaining one-fourth of the purchase money is subject to arrangement, but the company may demand that all, or some portion, of this one-fourth shall be paid in cash.

To many of our readers, the arrangements made for taking over the staff of the company will be a subject of close interest. The Postmaster-General will be prepared to take into his service a considerable proportion of the officers and servants on terms to be arranged between himself and them, but service under the company gives no claim to consideration at the hands of the Postmaster-General, either as regards service, emolument, pension, gratuity, or compensation, it being the intention of the agreement that any claim on the part of the officers or servants of the company arising from their service under the company, for pension or compensation, shall be dealt with by the company. We believe that the company has had a pension fund in existence for a number of years past. There is ample time to place this upon such a basis as will ensure that there shall be no hardship to old servants of the company from the transfer of the business to the State. That the Post Office should seek to avoid a repetition of their experience in superannuated officials from the telegraph transfer, is but reasonable, and the specific statement in the agreement that this is a duty the company will be expected to see to, ought to be enough to prevent any hard case arising with the staff of the company. Any officer who has been continuously in the service of the company from August 15th, 1904, to December 31st, 1911, and is then taken over and placed upon the permanent establishment of the Post Office will have a claim to superannuation allowance, notwithstanding that he may at the date of his retirement have served less than 10 years.

For the public at large, it will be of interest to note the provisions which have been made "in order to promote the use of the telephone" between the date of the agreement and December 31st, 1911. In the first place, the company must maintain their plant in good and efficient working order; they must not show favour or preference to any person, and shall not require from any person, as a condition to affording him telephonic service, any facility except for the purpose of giving such service to that person. A schedule of rates is attached to the agreement. The company's charges must not be more than the maximum nor less

than the minimum specified. The schedule does not apply to London. The maximum for a flat rate subscription is £10, and the minimum £5. In any cases where the company is now charging more or less, then the present charge is to be the maximum or minimum instead of the schedule. The effect of this provision seems to be that in any cases where more than £10 is being charged, the company can go on charging more, whilst in any cases of less than £5 they will be able to adjust their rates up to the maximum of £10. Terminal charges for trunk wire calls between National subscribers and Post Office subscribers are abolished. The provision in the London agreement whereby the Post Office undertook to supply underground wires on rental, is extended to the new agreement, and similar conditions are applied to switchboards in new or refitted exchanges.

We are unable, of course, to allude here to all the conditions in the agreement, an extended abstract of which appears on another page, and we may conclude with those important provisions which are made to ensure that the company's service does not "run down." By Clause 10 the Board of Trade can appoint an "impartial person" to inquire into representations of inefficient service in any exchange area, and if it is found that the service is inefficient (not caused by the unreasonable withholding of wayleaves by the local authority) the Postmaster-General may compel the company to put their service in order or may take it over at once.

Such precautions as this, and many others, are necessary in an agreement of this kind, but the agreement is itself the best safeguard against a relapse in the service of the company. Broadly interpreted, it is an arrangement for transferring from private enterprise to State control a large and growing business, on terms which shall ensure to the sellers the reasonable recoupment of all wise expenditure, so that it becomes the interest of the company to develop the business in every possible way on sound lines. The transfer of such a business is a serious undertaking, and the period between the conclusion of the agreement and December 31st, 1911, provides an interval during which plans may be matured, and an organisation established, so that the actual transfer will be simple and easy.

The agreement is between the State and a private company. The company's interests are simple; those of the State more complex. There is the obvious interest of the aggregate of individual taxpayers; and there is the less obvious, but equally strong, interest of the community in the development of an important means of communication. The settlement gives a just return to the investor who represents directly or indirectly, the "adventurer" who had the "grit" to embark upon an unknown enterprise which became of immense public benefit; it ensures to the taxpayer that for the price paid, tangible value will be received; and it encourages the investment of further capital for growth and expansion pending the change of ownership. It is because the agreement attains all these ends that it can be described as fair and reasonable.

Architects and Electric Light.

In the adjoining column we refer to a paper read by an architect before the Society of Architects, on the lighting of buildings. Apparently the author had nothing particularly new to state, but it is a hopeful sign that this subject is being taken up by architects generally instead of leaving the question of lighting to the builder or contractor. Of course certain architects have made a speciality of the lighting of interiors, and we need only look at some of the latest West-end theatres to see how successfully electric light has been used in order to secure the threefold advantages of good lighting, purity of atmosphere and pleasing artistic effects. We believe that many architects in matters of this sort consult electrical manufacturing firms in the drawing up of their designs and specifications; this is a practice that will always give the best results, as, although an architect has to know a great deal about some things, we cannot expect him to be conversant efficiently with everything. It is to the house-lighting question that the architect should devote more attention; and, if he studies the subject and his client at all, we cannot see how he can fail to provide for the electric light.

THE LIGHTING OF BUILDINGS, &c., BY ELECTRICITY AND BY INCANDESCENT GAS.

To those of us who are nurtured in an electrical atmosphere, and whose discussions of the subject are precise, it comes quite refreshing to hear "the man in the street" discourse on the advantages and (what he mistakenly considers) the disadvantages of electric light. It is on such occasions that the cry of Burns is answered: "O, wad some power the giftie gie us to see oorsel's as ithers see us" substituting, of course, "our works" for "oorsel's." Such was our interesting experience when, by kind invitation of Mr. B. R. Tucker, member of the Council of the Society of Architects, we attended on the 16th inst. at the meeting of this Society to hear him read a paper entitled as above. We use the term "man in the street" advisedly, for although an architect has a most difficult training to go through, and thereby acquires a large amount of scientific, artistic and mechanical knowledge, it is a fact that on a subject which is most closely associated with the design of interiors, he is, like Mr. Balfour, in another sphere, quite a child. For those who inhabit buildings, the question of lighting is so closely connected with comfort, health and artistic fitness, that it is a marvel that such an important factor of the completeness of a dwelling-house should be so often left to shift for itself.

The attempt of Mr. Tucker to interest his fellow workers in this matter was praiseworthy; the method in which it was carried out was perhaps open to a certain amount of criticism. In the first place, Mr. Tucker did not appear as a teacher or prophet; his paper was rather in the nature of that of a traveller who goes to America for a week, and then gives a lecture on the inhabitants, based partly on his experience, and partly on what they told him. We learned nothing of how buildings were to be lighted in order to secure the best effects based on the results of extended experience; but we were told how electric light and gas appeared to the author as a novice in such matters, and what he had been told by interested parties on either side. When it is related that the respective informers regarding the scientific data given were a contractor at London Bridge, and the manager of the South Metropolitan Gas Co., it will easily be inferred who made out the best case.

The paper itself contained little of a contentious nature, such remarks occurring rather when the author made a digression from the printed matter. This was divided into three parts, namely, (1) Introduction, in which certain well-known axioms and definitions were introduced, such as candle-foot, the method of measuring light, law of inverse squares, distribution and colour; (2) Electricity, in which the nature of arc, Nernst and incadescent electric lamps was described; and (3) Incandescent gas light, in which certain extraordinary claims were made and certain special forms of mantle lamps were described. The paper was fairly well illustrated by lantern slides. With regard to the technical errors made, it would, perhaps, not be fair to be too critical. We believe, for instance, that in a modern high-class enclosed arc lamp, the arc does not slowly travel from one part to the other of the space between the carbons, nor is the inner globe of opal glass. But the author objected very much to arc lamps for street lighting. He mentioned incidentally that on Clapham Common there is a dark space at the foot of each lamp-post, and then a circle of light about 30 ft. diameter, afterwards darkness again. He had a most unpleasant experience in Battersea in a fog, when he could not see one arc lamp whilst standing by another; whereas on turning a corner into a street lighted by incandescent gas, he was able to see two lamps at once—a remark that was received with some hilarity. He severely criticised the arc lamp for throwing the light on to the pavement, but he evidently failed to see that it is the pavement that has to be illuminated, not the surrounding fog.

The Nernst lamp was not approved of, because it took too long to light—he thought two minutes—and it required a "resister" to prevent the light becoming unstable. The incandescent electric lamp did not come in for any special criticism, but the maximum demand system is evidently still a terrible puzzle to the non-electrical mind, as is also the average cost of electrical energy as worked

out by this system. We were told, for instance, that "the rate per unit in the City of London supply varies from 2½d. to 5d. In one business house, 2½d. is charged per unit for current used in the daytime in the basement. 3½d. for that used on the ground floor, and 4½d. for the floors above," an entirely misleading way of describing the system of charging.

On the subject of gas lighting, the author was evidently more at home, and whilst we must leave all technical criticisms to our gas contemporaries, it is necessary to deal with one or two points that were raised. The improvements in incandescent gas lighting received some attention, especially an apparatus for lighting and extinguishing gas from a distance. It was pointed out that "this invention ensures economy and convenience in cases where gas light is only required at intervals"—a remark that would surely equally well fit the bye-pass burner.

However, Mr. Tucker was most ingenuous on the question of the advantages of incandescent gas over electric light, and we think his arguments are best answered by quoting them in full :—

> Natural ventilation is very much improved by the use of incandescent gas lighting. The heat of the burners not only causes a healthful circulation of the air within the room or building, but it materially assists in the removal of the vitiated air in all cases where a proper provision has been made for the escape of the same, and it undoubtedly assists in the prevention of down draught in certain cases in churches, halls, large rooms, &c.
>
> Some experiments were carried out in the Museum and Art Gallery at Birmingham, in 1902, and reported by Prof. Percy F. Frankland (Birmingham University), the results of which are most interesting and instructive. It is stated that the experiments clearly showed the following results under the condition of the efficient ventilation which prevailed at the time:—
>
> (*a*) In the absence of any artificial illumination, there was a slight increase in the percentage of carbonic acid in the air during the course of the day ;
>
> (*b*) With the electric arc lamp illumination, the increase in the percentage of carbonic acid was distinctly more marked ;
>
> (*c*) With the incandescent gas illumination, on the other hand, there was a distinct diminution in the percentage of carbonic acid in the air.
>
> It is stated that the explanation of this diminution is not far to seek, it being obviously due to the more efficient ventilation of the gallery, caused by the greater draught of heated air through the ventilating shafts placed above the incandescent gas burners. The circumstance that the percentage of carbonic acid actually diminishes during the use of the incandescent gas burners proves that the products of combustion from which damage to the pictures might be apprehended, are completely carried off by the ventilation, which is so much promoted by the gas-burners.
>
> In the opinion of Prof. Frankland, the incandescent gas installation in the Art Gallery is to be preferred to electric arc lamps ; and although these lamps do not give rise to sulphur compounds, they do generate ozone and oxides of nitrogen, which are calculated to act prejudicially on pictures. *In order that this advantage may accrue from the use of the incandescent gas illumination, it is of course, necessary that proper ventilation should be provided over the gas burners to prevent the circulation of the products of combustion.*

(The italics are ours.) We think we have heard something of this sort before, and seem to recognise the inspiration. But if architects will provide proper ventilation it is not necessary to use gas burners in order to carry off the vitiated air.

In the discussion that followed, the first speaker was Mr. Manning, who proposed a vote of thanks to the author. Like Rosa Dartle, he asked for information ; he wanted to know the comparative cost of electric and incandescent gas light. He also mentioned that he thought the latter much better for street lighting, and he had some ideas on the lighting of dining rooms by electric light ; you should have no lights round the walls, but a wide frieze with lights behind it. Still, he would like to know the cost.

Mr. H. H. Richardson seconded. He was a disappointed man. When electric light was first introduced, he thought there would be a great revolution in illumination, but this, in his opinion, had not been realised. It was bad indoors and bad out-of-doors. As a member of one of the old vestries (we wonder which ?) he had assisted in an investigation as to comparative cost for street lighting, and gas came out on top. No ; electric light was useful for basements and for decorative purposes ! What bathos ! We are glad there is still some use for electric light.

Another gentleman also supported the motion, but he was surprised to hear that there was more "carbonic acid" in a room lighted by electric light than in one illuminated by gas. His personal experience differed, and he felt better in the morning after spending an evening with the electric light. True, you might put a ventilating shaft over each gas jet, but that is an old tale.

The Secretary then called on "Mr. Murray, the eminent electrician," and Mr. Ruthven Murray, who had been lying low in the background, then set to work to roll out poor Mr. Tucker. The photometer the latter had described as the latest and most up to date (the invention of Mr. Carpenter, and used by the South Metropolitan Gas Co.) did not get over the colour difficulty, as was claimed. He objected to incandescent gas light owing to its ghastly green colour, which increased by age. He defended the arc lamp, and pointed out that if the pillar threw a shadow, it was easy enough to use a bracket. He considered flame lamps were causing the gas people much worry owing to their fog penetrating powers and extra light, and in connection with the Nernst lamp, he hinted at a new lamp having an earthy oxide burning in a vacuum. Touching on the Gas Exhibition, he said that the turning upside down of gas lights and making them look like electric light was the greatest compliment to the electric light, whilst the Exhibition had been the best possible advertisement for the latter owing to the awful ventilation. He ridiculed the Birmingham Art Gallery report, and pointed out that a 5-ft. gas burner consumes as much oxygen as 10 human beings. As regards comparative cost, gentlemen could take it that the ratio was 8 : 1—that is, electricity at 3d. was equal to gas at 2s. The audience looked puzzled, and appeared to be mentally figuring it out.

Another gentleman spoke about mercury vapour lamps, and described his unfortunate experience with the "action-at a distance" gas switches ; and then the President added a few words to state that he had found gas best for displaying goods in shop windows, a quite different opinion being evidently held by all the west-end shopkeepers.

Mr. Tucker then replied. He protested that he did not oppose electric light. He believed in both systems of illumination, and he liked to see the rivalry between them. Those arc lamps at Battersea he could not get over, but then many things were queer at Battersea. Doing away with the pillar was no good ; it was the negative carbon that got in the way ! He thought electric light was most desirable for some purposes—gas for others. He was not able to reply to the question about comparative cost, although he seemed to think that Mr. Murray had been getting at him. He would be happy, however, to go into the matter, and put the results of his investigation into the proceedings.

The last vision we had on leaving the room was that of Mr. Tucker and Mr. Ruthven Murray engaged in lively, but friendly, tilt.

THE LIABILITIES OF TRAMWAY CONTRACTORS.

The case of Thomas Tilling, Ltd., *v.* Dick, Kerr & Co., Ltd., in which Mr. Justice Warrington gave judgement on February 18th, involves the decision of a point of great importance to contractors who undertake the construction of tramways on behalf of local authorities. A report of the judgement will be found elsewhere in this issue. The facts of the case may, however, be briefly recapitulated. The defendants were under contract with the London County Council to re-construct and electrify for the Council certain tramway lines in South London, in accordance with provisions of the London County Tramways (Electrical Power) Act, 1900, the London County Council (Tramways and Improvements) Act, 1901, and the Tramways Act, 1870. In carrying out the work, the defendants found it necessary (in places where there were double lines of tramway) to work upon one track at a time. Instead of using a single line to meet the exigencies of the existing horse tramway traffic, they considered it better to lay bye-passes. These bye-passes consisted of tram rails laid on the roadway in such a way that they projected above, instead of lying level with, the surface. The plaintiffs were omnibus proprietors, who alleged that considerable damage had been caused to their vehicles in crossing these bye passes.

They claimed damages from the defendants on the grounds (*a*) that they had unlawfully obstructed the highway; (*b*) that they had been guilty of negligence in laying their tramrails in such a way as to be a source of danger to vehicular traffic. The interest of the case lies in the nature of the defence which was put forward by the defendant company. They alleged that (1) as to all the plaintiffs claim, they (the defendants) were protected, inasmuch as they had been acting in pursuance of a statutory power or duty; (2) as to some of the damages, which were made up of a number of small claims in respect of injuries done to a number of omnibuses belonging to the plaintiffs, they were protected by the Public Authorities' Protection Act, 1893, inasmuch as the action had not been launched within six months of the date of the injury.

By Sec. 6 of the London County Tramways (Electrical Power) Act, 1900, the County Council, "for the purpose of working the tramways by electrical power, or for providing access to or forming connections with any generating station or stations, engines, machinery, or apparatus, may exercise the following powers (that is to say)—

"They may place, lay down, construct and maintain on, in, under *or over the surface of any street* . . . . such posts, conductors, wires, cable and apparatus and may make maintain such openings and ways in or under the surface of any street as may be necessary or convenient for such working. And they may reconstruct or make such alterations of the tramways, and may execute all such works on or in connection therewith in, over, or under the streets or roads in which the same are laid, as may be necessary for adapting the same to be so worked." It was claimed that, upon the general principle of law, no action lies for damage occasioned in the course of performing a statutory duty, the defendants were not liable, having regard to the provisions of the above section.

Mr. Justice Warrington found that the defendants had not been guilty of negligence—*i.e.*, that their method of carrying out the work which they had to perform, was satisfactory. With reference to Sec. 6 he said:—"It is contended that the works constructed by the defendants are works necessary for adapting the tramways to be worked by electricity, and are, therefore, authorised by this section. It is to be observed that the section appears to point to permanent alterations, and not to temporary expedients for carrying on the tramway traffic. I cannot adopt the defendants' construction; in my opinion, the works they have constructed are not necessary for adapting the tramways to be worked by electricity, but were necessary (if at all) for maintaining the tramcar service uninterrupted. Works for this purpose are, in my judgement, not covered by the Act, and the defendants are accordingly not protected by it."

Pausing here, the decision of his Lordship upon this point is one of considerable importance. It amounts to this, that if any tramway company, or local authority working tramways, obtains power to electrify their system, and for this purpose finds it necessary to make temporary works in order to cope with existing traffic, they must carry out such temporary works at their peril. The significance of this principle may best be explained by considering the position of one who is carrying out works authorised by statute. Many years ago an action was brought against a railway company, to recover an amount assessed by a jury as compensation for vibration from the use of the railway after construction. The damage did not arise from negligence, but was the inevitable consequences of the proper and ordinary use of the railway. It was decided that no action would lie for the damage sustained; the legislation having given power to the company to employ locomotive engines, and such locomotives cannot possibly be used without occasioning vibration and consequent injury to neighbouring houses (Hammersmith and City Railway Co. *v.* Brand 4 L.R.H.L., p. 171). Applying the principle of this case to that now under consideration, it is clear that the question for the Court was whether the provision of bye-passes was necessary and incidental to electrification. This is a question which the learned judge has decided in the negative; but looking at the nature of the proposed works for electrification, and to the fact that those works were to be carried out on an existing tramway, it is at least open to argument that the contractors were entitled to lay down bye-passes.

In view of the decision of the Court upon the other part of the case (to which reference will presently be made), the accuracy of his Lordship's decision upon the present point was not vital to the issue. We trust, therefore, that his ruling will not be considered final, for it might have untoward consequences. Assume, for instance, that an existing electric lighting company obtained powers to enlarge their generating station; and that the works were of such a nature as to involve the erection of temporary works in order to meet the demands of consumers. In accordance with the decision of the present case, the erection of such works would not be incidental to the alterations, and in erecting them the company would be entitled to no protection.

Upon the second question—namely, whether the contractors were entitled to the benefit of the Public Authorities' Protection Act—the judge again found in favour of the plaintiffs. Shortly, the advantages conferred by the statute are that an action must be brought within a certain time, and that, if unsuccessful, the plaintiffs must pay the defendants' costs on a scale higher than that which is usually applied. The first of these advantages was material to the contractors in the present case, inasmuch as many of the injuries claimed for, had been occasioned to the omnibuses more than six months before the date of the writ. The Public Authorities Protection Act, 1893, so far as is material, provides that:—"Where after the commencement of this Act, any action, prosecution, or other proceeding is commenced in the United Kingdom against any person for any act done in pursuance, or execution, or intended execution, of any Act of Parliament, or of any public duty or authority, or in respect of any alleged neglect or default in the execution of any such Act, duty, or authority, the following provisions shall have effect—(*a*) The action, prosecution, or proceeding shall not lie or be instituted unless it is commenced within six months next after the act neglect, or default complained of."

In the present case the question was whether this section applied so as to protect a contractor carrying out works on behalf of a local authority. Mr. Justice Warrington on this point said:—"In the absence of authority, I should have been prepared to hold that contractors undertaking work for their own profit are not within the protection of an Act passed as this is 'for the protection of persons acting in the execution of statutory and other public duties.'" In support of his decision, however, the learned Judge referred to a case where the Court of Appeal had very recently decided the point adversely to contractors. If the contractors could be said to be acting as the servants of the local authority, they would clearly have been entitled to the benefit of the Act. Had the County Council in the present case done the work themselves, they would clearly have been protected.

We have sometimes had occasion to comment upon the Public Authorities' Protection Act, and have more than once emphasised the fact that a meed of protection is given to the municipal trader, which is denied to electric tramway or supply companies. It is something of an anomaly that even when a firm of contractors are acting solely on behalf of a local authority they are not entitled to protection, especially when the works which caused the mischief were carried out for the purpose of enabling the County Council to continue running their tramways. It is presumed, however, that in the case in question the contractors have taken care to have an indemnity from the County Council.

The case will, at any rate, draw the attention of tramway contractors to the fact that such an indemnity may be a matter of real necessity, seeing that in the conduct of certain parts of their works they are under no statutory protection of any kind.

THE TELEPHONE AGREEMENT.

[Abstract of Agreement dated February 2nd, 1905, between His Majesty's Postmaster-General and the National Telephone Co. Ltd.]

The agreement recites the licence of November 29th, 1884, the Trunk Line Agreement of March 25th, 1896, the London Agreement of November 18th, 1901; refers to the various extensions of licences in certain areas, the existence of the company's private

wire business; states that it has been agreed that the company shall cease to transact any telephonic business after December 31st, 1911, and then proceeds to define the terms now entered into.

1. The first clause is an interpretation clause.

2. (1) Subject to the provisions of this Agreement the Postmaster-General shall buy and the company shall sell and convey on December 31st, 1911:—

(*a*) All plant, land and buildings of the company brought into use with the sanction of the Postmaster-General and in use by the company on December 31st, 1911, for the purposes of licensed telephonic business of the company.

(*b*) Any licensed telephonic business of the company, which, by virtue of the Telegraph Act of 1889, or of any of the Agreements in writing between the Postmaster-General and the company, particularly specified in the first schedule hereto or of any other Agreement in writing between the Postmaster-General and the company (whether made before or after the date of this Agreement) can be transacted for any period after December 31st, 1911.

(*c*) Any private wire business of the company, together with all plant, land and buildings in use by the company on December 31st, 1911, for the purposes of such business;

(*d*) All stores which on December 31st, 1911, are in the company's possession and which are suitable for use in accordance with the methods of work described in the specification and rules set forth in the Third Schedule hereto, and all furniture in the company's possession at the same date, provided such stores and furniture are reasonably necessary for the purposes of the telephonic business of the company according to the ordinary and business-like way of carrying on such business.

(2) Spare plant of all descriptions in the possession of the company on December 31st, 1911, including works of all kinds in course of construction at the same date (provided such plant and works are reasonably necessary for the purposes of the telephonic business of the company according to the ordinary and business-like way of carrying on such business) shall be deemed to be plant in use by the company on December 31st, 1911, for the purposes of the company's telephonic business

(3) Plant, land and buildings, shall be deemed to have been brought into use with the sanction of the Postmaster-General, if such plant, land and buildings, comply with one of the following conditions, but not otherwise (that is to say):—

(*a*) If such plant, land or buildings, are in use (or are in process of being brought into use) for the purpose of the company's business at the date hereof; or

(*b*) In the case of plant, if such plant is after the date of this Agreement, constructed by the company in accordance with the specification and rules set forth in the Third Schedule hereto; or

(*c*) In the case of land and buildings, if such land and buildings are, after the date of this Agreement, acquired or constructed with the consent, in writing, of the Postmaster-General.

Provided that no exchange which has a capacity of more than 300 direct subscribers' lines, and the construction of which was commenced after August 15th, 1904, shall be deemed to have been brought into use with the sanction of the Postmaster-General, unless its site and capacity shall have been approved, in writing, by the Postmaster-General, or unless at the time when the question arises it shall be determined by arbitration that such exchange will be suitable for the requirements of the telephonic service of the Post Office on December 31st, 1911.

3. (1) In the case of—

(*a*) Plant not constructed in accordance with the specification and rules set forth in the third schedule hereto (other than switchboards and internal exchange plant in use on August 15th, 1904, and specified in a list furnished by the company to the Postmaster-General within six months from the date of this Agreement), and

(*b*) Plant of any kind, land and buildings in use on January 1st, 1911, for the purposes of the company's licensed telephonic business in competitive exchange areas (whether such plant is constructed in accordance with the said specification and rules or not), the Postmaster-General may by notice in writing given to the company not later than January 1st, 1911, object to buy such plant, land or buildings as he considers will be unsuitable for the actual requirements of the telephonic service of the Post Office on December 31st, 1911.

Sub-clauses (2), (3) and (4) provide arbitration in case of any difference regarding the suitability of plant, lands or buildings, and give the Postmaster-General right to object to purchase certain plant in competitive exchange areas.

4. (1) The value on December 31st, 1911, of all plant purchased by the Postmaster-General in pursuance of the provisions hereof shall be deemed to be its fair market value at the time of the purchase, due regard being had to the nature and then condition of such plant, and to the state of repair thereof and to the circumstance that it is in such a position as to be ready for immediate working and to its suitability for the purposes of the Postmaster-General's telephonic service and no addition shall be made to such value, in respect of compulsory purchase or of goodwill or of any profits which might have been or be made by the company, by the use of such plant, and in determining the value of any plant no advantage arising from the construction of such plant by leave of the Postmaster-General upon any railway or canal over which the Postmaster-General possesses exclusive rights of way for telegraphic lines shall be taken into account.

2. The value on December 31st, 1911, of all land, buildings, stores and furniture purchased by the Postmaster-General in pursuance of the provisions hereof shall be the fair market value thereof at that date.

(3) The value on December 31st, 1911, of any licensed telephonic business of the company which, by virtue of the Agreements referred to in the First Schedule hereto, or of any other Agreement in writing between the Postmaster-General and the company, can be transacted as aforesaid after December 31st, 1911 (apart from the plant, land and buildings used therein, which are to be valued as hereinbefore in this clause provided), shall be such sum as may be agreed between the Postmaster-General and the company, regard being had to the net profits of such business and to the circumstances and conditions under which the company would carry on such business after December 31st, 1911.

(4) The value on December 31st, 1911, of any private wire business of the company (apart from the plant, land and buildings used therein which are to be valued as hereinbefore in this clause provided) shall be taken to be three years' purchase of the net profits of such business, on the average of the three years ending on December 31st, 1911.

(5) All matters of difference arising under this clause shall be determined by arbitration.

5. The Postmaster-General shall have the option of purchasing on December 31st, 1911, any property or assets of the company not specified in the preceding clauses of this Agreement, and the price to be paid therefor shall be determined by arbitration in case the parties differ.

6. Clause 6 relates to the transfer of the business at December 31st, 1911.

7. Subject as herein provided, the Postmaster-General shall have the option of paying the purchase money payable under this Agreement by way of terminable annuities running over a period not exceeding 20 years, such annuities being calculated so as to pay the whole of the purchase money by the end of the period fixed, with interest in the meantime on the balance outstanding from time to time at the rate of £3 per cent. per annum payable quarterly, provided that if the company so require, such proportion of the purchase money as may be specified by the company not exceeding one-fourth part thereof shall be paid in cash.

8. With regard to the officers and servants of the company the following provisions shall have effect:—

(1) It is probable that the Postmaster-General will be prepared, upon the transfer to him of the plant, property and assets of the company, as provided by this Agreement, to take into his service a considerable proportion of such officers and servants, on terms to be arranged between himself and them, but the Postmaster-General will not accept any obligation to recognise service under the company as giving any officer or servant any claim to consideration at the hands of the Postmaster-General, either as regards service emolument pension, gratuity or compensation, it being the intention of this Agreement that any claim on the part of the officers or servants of the company arising from their service under the company for pension or compensation, shall be dealt with by the company.

(2) If any officer or servant who has been continuously in the service of the company, from August 15th, 1904, to December 31st, 1911, is taken into the service of the Postmaster-General and placed upon the permanent establishment of the Post Office, his service, under the Postmaster-General shall (provided the authority of the Treasury or of Parliament be obtained in that behalf) give him a claim to a superannuation allowance after the rate and under the conditions provided by the Superannuation Acts, 1834 to 1892, or any statutory modification thereof, notwithstanding that he may, at the date of his retirement, have served less than 10 years.

9. Clause 9 defines the conditions under which the company is to carry on the business until 1911. The plant is to be maintained in efficient working order; no preference is to be shown to any subscriber. The charges must be within the terms scheduled. Terminal fees with Post Office subscribers are abolished. The Post Office will, if required, provide underground works, and switchboards upon the terms defined in the London Agreement.

10. If at any time before December 31st, 1911, representations are made to the Postmaster-General that the company are giving an inefficient service in any exchange area, and upon an inquiry by an impartial person appointed by the Board of Trade (at which inquiry the company and the person or persons making the representations shall be entitled to be heard by counsel and to adduce evidence) it shall be ascertained by the award of such person that the company's service in that area is inefficient, and that such inefficiency is not caused by the unreasonable withholding of wayleaves by any local authority, it shall be lawful for the Postmaster-General at his option, either to require the company to take such steps as he may deem necessary to render their service efficient, or to call upon the company to sell to him the plant, land and buildings used by them in such exchange area. In the first case, if the company make default in complying with the Postmaster-General's requirements, and in the second case, forthwith the company shall sell to the Postmaster-General the plant, land and buildings used by them as aforesaid, and all the provisions of this Agreement in relation to the sale to the Postmaster-General of the company's plant, land and buildings on December 31st, 1911, shall apply to a sale under this clause, so far as such provisions are applicable. Upon such day as the Postmaster-General shall fix in such case, the company's license to transact telephonic business in such area shall cease, and the company shall not be entitled to any payment in respect of compulsory purchase or goodwill or prospective or hypothetical profits in respect of their business in the said area.

11. Clause 11 relates to certain modifications in the London Agreement to accord with the new Agreement.

12. Clause 12 is a formal undertaking by either party to do, or cause to be done, all that may be necessary to carry out the Agreement.

13. Clause 13 provides that the Agreement is not to be assigned.

14. Clause 14 retains for the Postmaster-General all rights to establish, extend and maintain and work any system or systems of telegraphic communication.

15. Clause 15 provides that the Railway and Canal Commission shall be the arbitrators under the agreement, if that body are authorised to so act.

16. Clause 16 relates to notices to be sent at any time.

17. This agreement shall not be binding if at any time before August 31st, 1905, a resolution of either House of Parliament requesting the Postmaster-General not to give effect to the agreement shall be passed, provided that the agreement shall become binding at any time if it is approved by a resolution of the House of Commons.

The schedules to the agreement we must reserve for a later issue.

LEGAL.

PFLUGER ACCUMULATORS.—ALLEGED BREACH OF AGENCY AGREEMENT

IN the Commercial Court of the King's Bench Division on Thursday, February 16th, Mr. Justice Bray commenced the hearing of the case of Sanders Rehders & Co. *v.* Pfluger Accumulatoren Werke Aktien-Gesellschaft, of Berlin, which was an action to recover damages for alleged breach of an agreement, under which the defendants appointed the plaintiffs their sole agents in this country for 10 years, for the sale of the Pfluger stationary and portable accumulators.

Mr. Rufus Isaacs, K.C., and Mr. Bailhache appeared for the plaintiffs, and Mr. Ernest Pollock for the defendants.

It was intended that the case should be tried by a special jury; but, owing to the illness of Mr. Lawson Walton, K.C., who had been briefed by the defendants, it was agreed, rather than postpone the hearing, that the jury should be dispensed with.

Mr. RUFUS ISAACS stated that the defendants were manufacturers of a special kind of accumulator, used for electric lighting and in the motor trade. The plaintiffs, who carried on business at 108, Fenchurch Street, were under a contract to represent the defendants for a period of 10 years from November 21st, 1903, subject to determination in certain events which had not happened. Nevertheless, the defendants had put an end to the contract by notice given in June, 1904, and thereby committed a breach of the agreement. They had refused to employ the plaintiffs any further, and his case was that his clients were entitled to damages calculated upon the profits and commission, which would have been earned if the contract had been carried out for the full 10 years. One question of fact his Lordship would have to decide upon the construction of the document which formed the contract, was whether there was on the part of the defendants, when they gave this notice, any *bond fide* intention of discontinuing, being represented or carrying on business in this country. The contract in question was to continue until November 1st, 1913, and the plaintiffs were to have a commission of 2½ per cent. on the orders obtained for stationary batteries, and of 5 per cent. on portable batteries, with a percentage also of the net profits earned. The defendants were to have the right to determine the agreement in case they decided to entirely discontinue the representation in England or in the event of a sale to a third party. In the latter case, provision was made for the payment of an indemnity to the plaintiffs. Work was carried on under the contract for some time, but on June 18th last the defendants wrote dismissing the plaintiffs as from October 1st, stating that the business had not come up to their expectations, and as there was no prospect of its doing so within a reasonable time, they had decided to entirely discontinue the representation. Subsequently, however, the defendants issued to customers, a notice of their intention to establish a factory in Coventry. The notice also stated that the defendants were taking commodious offices in Albany Street, Westminster. Further evidence was given to show that defendants had no intention of discontinuing the business.

Mr. POLLOCK, in reply to his Lordship, said the defence was that the agreement contemplated both business done by the plaintiffs as defendants' agents, and also that the defendants should be entitled to do business direct, subject to the plaintiffs' right to commission and a percentage of the profits. On his construction of the agreement the defendants had the power to drop the agency, if they found it unprofitable (and he would call evidence to show that the expenses made it unremunerative), in which case the plaintiffs were entitled to commission for the 10 years, but not to profits; but plaintiffs could not accede to the contention of Mr. Rufus Isaacs, that under no circumstances could they put an end to the agency without withdrawing their business from this country.

His LORDSHIP thought that the question of whether the defendants really intended, when they gave notice to the plaintiffs, to give up everything in England might become important, and Mr. Pollock proceeded to call witnesses who declared that this was the intention at the time, and was only altered some six weeks later.

At the resumed hearing on Saturday, Mr. ISAACS stated that the parties had come to terms, and that by consent, judgement would be entered for the plaintiffs for £2,500, this sum to include costs, and Mr. J. C. Pfluger guaranteed payment of this sum in cash, on Tuesday next, and that ended the matter.

Mr. POLLOCK stated that the defendants had brought this difficulty upon themselves by only partially instructing their legal advisers, who were told only a portion of the information which it was really necessary should be placed before the Court. He hoped his Lordship would allow him to say that his client, Mr. Davis, was also misled in this matter, because a full disclosure was never made to him, either of the circumstances or of the documents.

His LORDSHIP said he should draw the same inference, and would, as far as he could see, have awarded a sum not far off the sum which had been agreed upon. It might be a satisfaction to the parties to know that.

MACARTNEY, MCELROY & CO. *v.* THE BRIGHTON CORPORATION.

THE hearing of this case commenced on Friday, February 10th, in the Court of Appeal, composed of the Master of the Rolls and Lords Justices Mathew and Cozens-Hardy, on the application of the defendants for judgement, or, alternatively, a new trial of the action which was heard before Mr. Justice Grantham and a special jury in the King's Bench Division. Mr. Fletcher Moulton, K.C., Mr. Boxall, K.C., and Mr. C. C. Scott appeared for the appellants, and Mr. Montague Lush, K.C., Mr. H. S. Cantley, and Mr. M. Blundell for the respondents.

Mr. MOULTON, in opening the case, said the action was brought by the plaintiffs, a firm of wood-paving contractors, in respect of a contract for paving, in connection with the electric tramway scheme of the Brighton Corporation. The action was tried before Mr. Justice Grantham and a special jury, and the judgement, so far as the principal part of it was concerned, was a judgement for the rectification of the contract in question. The ground of the present application was that there was no evidence whatever to go to the jury in support of the plaintiffs' case, and the defendants asked on various other grounds for a new trial. The plaintiffs claimed that there was a mistake in the price that they named, and that they omitted to allow for the excavating and concrete work; and they therefore said that the sum named in the contract ought to be increased so as to cover the cost of this work. On the other hand, the Corporation alleged that the contract was for a lump sum for the whole of the work. At the trial, the jury found that the lump sum was too small, owing to an error, by something over £14,000, and the learned judge held that the intention of both parties was to make a contract whereby the plaintiffs were to be paid, in addition to the sum named in the contract, the whole cost of the excavating and concrete work.

Lord Justice MATHEW asked whether the plaintiffs were not entitled to a reasonable sum in respect of the work, the cost of which, they said, was omitted from their figures.

Mr. MOULTON said that the only way the plaintiffs could succeed on their claim, was by showing that there was a mutual mistake. The contract in question was with a local authority under the Public Health Act, and it was given under the seal of the Corporation in accordance with Sec. 174 of that Act, which required that all contracts for sums above £50 should be given under seal. The learned counsel having dealt with the evidence in detail, said that the burden was on the plaintiffs, of showing that the contract which was signed, was not the contract which both parties intended. It was impossible to show that the Corporation intended to enter into an agreement under which they were to pay, in addition to the lump sum, a sum of £14,000. The only contract which was now in the minds of the Corporation, was the one that was, in fact, signed, and no other. The learned counsel contended that the contract being under seal, it could not be rectified unless there was something clearly identifying the intention, otherwise than that expressed in the contract. He submitted there was no such evidence, and as a matter of law there could be no rectification.

Mr. BOXALL followed on the same side.

On their Lordships taking their seats on Thursday, Mr. MOULTON stated that the parties had agreed to terms, and the Court would not be further troubled with the case.

Mr. CANTLEY said there would be judgement for the agreed amount, which would end the whole of the litigation.

The MASTER OF THE ROLLS said he was gratified to hear it, and he considered the parties had acted judiciously.

KAY *v.* THE BRITISH WESTINGHOUSE ELECTRIC AND MANUFACTURING CO., LTD.

IN the Court of Appeal on 17th inst., the Master of the Rolls and Lords Justices Mathews and Cozens-Hardy, this case came on for hearing on an application by the defendant company asking for judgement or alternatively for a new trial of the action which was heard before Mr. Justice Jelf and a special jury at the Manchester Assizes in July. Mr. Dickens, K.C., and Mr. Ellis Hill appeared for the appellants, and Mr. A. H. Lazarus Langdon, K.C., and Mr. Edward Acton for the respondent.

Mr. DICKENS, K.C., in opening the case, said that the action was brought by the plaintiff, who was a workman in the employ of the defendants, to recover damages in respect of injuries caused by his falling against an electric switch, part of the electric lighting apparatus of the defendants' factory at Manchester, and getting burnt by the current. The plaintiff's case was that the defendants had been guilty of negligence, and that they had committed a breach of duty under the Workshops and Factory Acts by reason of their not having fenced in alleged dangerous parts of the machinery of the factory, namely, the switch in question. Alternately the plaintiff said the defendants were guilty of negligence in not supplying safe and efficient plant for the carrying on of their business. In defence it was pleaded that the switch in question was not machinery either within the ordinary meaning of the word or within the meaning of the Factory Acts; and, secondly, that if there was negligence it was not the negligence of the defendants, but that of a fellow servant of the plaintiff, namely, the general manager of the factory. On the point under the Factory Acts the learned judge at the trial expressed the opinion that the switch in question was not part of the machinery within the meaning of the Statute, and

reserved his decision on that question. He, however, left the question of common law negligence to a jury, who returned a verdict for the plaintiff with £850 damages. The ground of the present appeal was that the learned judge misdirected the jury—in the first place by telling them that the defendants were liable for the negligence of their servant; and secondly by holding that the defence of common employment set up was not an answer to the claim, notwithstanding the fact that the whole management of the factory was left in the hands of the manager. Proceeding, counsel explained the circumstances of the accident. He submitted that the defence of common employment was a good defence against the claim at common law. It was proved at the trial that the whole management of the factory was handed over to the general manager, that the switches in question were put up at his orders without the knowledge of the directors of the company, and that the work of covering them was being carried out by an employé of the company. It was quite clear as a matter of law that the manager of a company was the fellow servant of an ordinary employé of the company, and counsel's submission was that the negligence, if any, was the negligence of a fellow servant, and that, therefore, the company was not liable.

Dealing with the question of whether the switch was machinery which the company was under a statutory obligation to fence, counsel submitted that it was not. A mere switch had no connection with the machinery of the factory, and was used in the same way, and exactly for the same purpose as the tap to a gas bracket

Lord Justice Mathew: What do you say as to a lift?

Mr. Dickens said he was of opinion that that was plant. He could not see how a switch could be considered in any sense a machine. A machine was a contrivance by which either power or motion was produced by means of steam, water, or other mechanical contrivance. There was nothing of the kind here.

Mr. Ellis Hill followed on the same side.

The Master of the Rolls gave judgement. He said there was abundant evidence in justifying the jury in coming to the conclusion they did, and the learned judge in the course of his summing up, indicated more than once the true point, and was fully alive to the pitfalls and difficulties of the law relating to the case. There was ample evidence to show that the system of live electric wires, unguarded, was defective, and it was proved that this fact was brought to the knowledge of the board of directors. The very mischief which had caused the accident, had attracted the notice of the Board of Trade inspector, who caused formal notice to be served upon the company, and Mr. Westinghouse, one of the directors, must have seen the switches unguarded when going through the place. He was a specially skilled person, and, therefore, one who would have been acute in observing the fault which had been brought to the notice of the board by the inspectors of the Board of Trade. The evidence submitted to the jury, was sufficient to saddle the governing body with the obligation of dealing at once with the crying mischief and possible danger from these live points. As regarded the question of whether the switches were machinery within the meaning of the Factory Acts, it was not necessary to decide that point, and he desired to reserve his opinion upon it. It was enough for him to say that, on the main point, there was no reason to complain either of the summing up of the learned judge or of the verdict of the jury. Lords Justices Mathew and Cozens-Hardy concurred.

The appeal was accordingly dismissed with costs. A stay of execution, with a view to taking the case to the House of Lords, was refused.

T. Tilling, Ltd., *v.* Dick, Kerr & Co., Ltd.

Mr. Justice Warrington, on Saturday, gave judgement in this action, in which the plaintiffs sued the defendants for damage caused to their omnibuses by certain obstructions placed in the highways, over which they travelled, by the defendants. The defence was twofold. The defendants first said that the obstructions were placed in the road under statutory authority, and, secondly, that they were protected by the Public Authorities' Protection Act, 1893, the action having been brought more than six months after the cause of action proved. Plaintiffs said that even if the acts complained of were done under statutory authority, the defendants were negligent in the exercise of their powers, and were, therefore, liable. His Lordship found, as a fact, that negligence was not proved. The London County Council, prior to 1900, purchased, under statutory powers, the South London tramways, and by the London Tramways Electric Power Act, 1900, substituted electrical for horse traction. His Lordship then read the section of the Act affected. The special Acts of the London Tramways Co. and the General Tramways Act provided that the uppermost surface of the rail should be on a level with the surface of the street, and that the rights of the public to pass over or along the streets should not be abridged, save as in the Acts provided. For the purpose of converting the tramways, the Council made a contract with the defendants dated December 31st, 1902, by which the latter undertook the work described therein and in the specification annexed, at a certain price. The specification provided, amongst other things, that the contract should include the provision and maintenance of all temporary lines, turn-outs and cross-over roads to be used during reconstruction. The contract and specifications contained provisions casting upon the defendants the duty of observing the provisions of the statutes, and the responsibility for all damage caused by interference with traffic, or otherwise. Clause 13 of the specification directed the contractors to lay flush or raised temporary lines as required between the turn-outs, or, if so ordered by the engineer or his representative, to ensure that the process of excavation and removal of sewers, pipes, wires, &c., or the general process of reconstruction should interfere as little as possible with the regular tramway services along, or crossing, the road. At the trial, a portion of Romney Road, opposite the Royal Naval College, was taken as an example of what had been done by the defendants. The temporary line was constructed on rails with a bevel on either side from the ground to the height of 2 in. or thereabouts, and with a groove on the top to take the flange of the wheel. The uppermost surfaces of the rails were, therefore, not on a level with, but above the surface of the street. At intervals there were clamps and nuts projecting above the surface of the raised rails. At the two ends of each section so dealt with, called a turn-out, a junction was made between the temporary line and the permanent tramway. The plaintiffs were omnibus proprietors using the roads in which the work was being done. He found, as a fact, that the rails were an obstruction to the highway, and caused damage to the plaintiffs' omnibuses. There was evidence, which he accepted, that it would have caused great public inconvenience to interrupt the service of the cars, and that less real interference to ordinary traffic was caused by the construction of the turn-outs than by carrying on a tramcar service on a single line with cross-overs at intervals.

The first question was—were the acts of the defendants authorised by the statutes? It was, he thought, clear that the acts of the defendants would be a cause of action to the plaintiffs unless they were so authorised; and further, that if the acts in question were authorised expressly or by necessary implication, the defendants would be excused, although the doing of them might occasion a nuisance public or private. It was contended that the works constructed by the defendants were works necessary for adapting the tramways to be worked by electricity, and were therefore authorised by Sec. 6. He could not adopt the defendants' construction. In his opinion the works they had constructed were not necessary for adapting the tramways to be worked by electricity, but were necessary (if at all) for maintaining the tramcar service uninterrupted. Works for this purpose were, in his judgement, not covered by the Act, and the defendants were accordingly not protected by it. Then arose the question whether, as to causes of action arising more than six months before the date of the writ, the action was barred by the Public Authorities' Protection Act, 1893. It had been held that the protection of the Act extended to the officers of a public body and to persons acting under their direct mandate; but there was no case deciding that it extended to independent contractors doing under contract and for their own profit the works which the public body were authorised to do. In the absence of authority he would have been prepared to hold that contractors undertaking work for their own profit were not within the protection of an Act passed as this was "for the protection of persons acting in the execution of statutory and other public duties." In the first place, it was clear to him that the Public Authorities' Protection Act, 1893, had no application to this case. It was admitted, and rightly admitted, on behalf of the respondents that they could not say that this was an action, prosecution or proceeding against a person, which included a corporation, for an act done in pursuance or execution, or intended execution, of the defendants' public duty or authority. When the facts of the case were considered, it was clear that this action did not fall at all within those words which he had just read. The damage done to the road in question was done by certain contractors, and those contractors were not the servants, or agents, of the defendants in doing that damage. The contractors were simply persons who contracted to deliver certain stone and material within the limits of the defendants' borough; and the way they should do that was for them, and not for the defendants to consider. Therefore, it certainly could not be said that these acts were anything done by the defendant corporation in pursuance, or execution, or intended execution, of any Act of Parliament or any public duty or authority, and he need scarcely point out that it certainly could not be said that the contractors, when they did damage, were acting in pursuance or execution, or intended execution, of any Act of Parliament, or in consequence of any public duty and authority if they had none. That showed to his mind that this Act had no application to the present case. In his opinion, therefore, the plaintiffs were entitled to the relief they asked. It was agreed that the damages were to be ascertained by some form of reference. The defendants must pay the costs up to and including judgement. He proposed, therefore, to make a declaration that the plaintiffs were entitled to recover damages in respect of the matters complained of in this action, and to refer it to the Official Referee in rotation to ascertain the amount of such damages. The plaintiffs were also entitled to costs up to judgement; the subsequent costs to be dealt with by the Referee.

A stay of execution was granted pending an appeal, and it was agreed to stay the reference to the Official Referee until after the hearing of the appeal if notice of appeal was given within 14 days.

Jandus Arc Lamp and Electric Light Co., Ltd., *v.* The Arc Lamp, Ltd.

This case again came before Mr. Justice Kekewich in the Chancery Division of the High Court of Justice on Monday. Mr. Fletcher Moulton, K.C., Mr. T. Terrell, K.C., Mr. J. C. Graham, and Mr. A. J. Walter for the plaintiffs; and Mr. Bousfield, K.C., and Mr. J. H. Gray for the defendants.

Prof. Cormack, Mr. Swinburne and Prof. Adams gave further evidence as to various experiments made by plaintiffs.

Mr. Gray, in summing up the defendants' case, submitted that size, diameter, or capacity had nothing whatever to do with the life of the carbon. On the evidence of Mr. Swinburne alone, he argued that the experiments proved conclusively that nothing whatever could be concluded so far as plaintiffs' experiments were con-

cerned, even to prove a *primâ facia* case, that size had anything to do with the life of the carbon. Experiments of this kind could not possibly be conducted except over a long period of time, and after a great deal of repetition,

His LORDSHIP: As at present advised, I do not intend to pay any regard at all to experiments. In my opinion the experiments would be no safe guide, and I do not mean to regard them at all.

Mr. GRAY said, in view of what his Lordship had stated, he would not comment on the experiments further than to say that they proved nothing. The onus was upon the plaintiffs to prove that size was a feature of any importance, and they had failed to do so. Plaintiffs had proved nothing except that tightness was of importance, and that point defendants admitted. With regard to anticipations, counsel submitted that there was no more complete or comprehensive direction to prevent air getting into the globe than was contained in Beardsley. The Beardsley specification was an absolute anticipation, so far as the life of the carbon was concerned. As to the question of utility, counsel said that somewhat visionary evidence had been given as to the sale of the Howard patent. It had been said that the Howard patent was responsible for a revolution in electric arc lighting. The Jandus Co. began in 1895 to sell enclosed arc lamps. They sold a considerable number of Jandus lamps made under the Jandus patent, and it was not till 1896, three years after the date of the Howard patent, that they acquired that patent. Upon the evidence they acquired it, not because it was a wonderful epoch-making patent, but because there was a claim for an inner and outer globe.

His LORDSHIP said the evidence of Mr. Dugald Clerk was that the Jandus Co. acquired the Howard patent because it was thought that they were infringing it.

The learned counsel, proceeding, said the plaintiffs had never told his Lordship what particular point appeared in the Howard that did not appear in the Jandus patent. He submitted that upon the evidence no lamp made according to the true Howard specification had ever been put upon the market. No lamp made according to fig. 2 of the Howard specification could ever be placed on the market successfully. As to the question of subject matter, counsel submitted that there never had been a case decided in the Courts in which a mere alteration of size had been held to be subject-matter for a patent.

His LORDSHIP said that for reasons which he would afterwards state, he proposed to hold that the Howard patent, so far as they were concerned with it, was that Howard claimed to have invented a lamp enclosed in a small envelope, practically tight but yet allowing escape of gases at the top. That Howard attained what he claimed, namely, an increase in the life of the carbon, and further, that the invention had been commercially useful, and had not been anticipated. He wished to hear the plaintiffs' counsel in reply on the question of subject matter.

Mr. FLETCHER MOULTON argued that the change of scale might be a most important practical step towards revolutionising and altering widely the general practice. There was no enclosed lamp before the date of this patent. Now all the best lighting was by enclosed lamps. The learned counsel quoted a number of authorities in support of his contention—that there was proper subject matter.

His LORDSHIP reserved judgement.

SPAULL *v.* JOHNSON AND OTHERS.

MR. JUSTICE WARRINGTON, in the Chancery Division on Monday, heard this action, in which the plaintiff, Bernard A. Spaull, partnership negotiator and general business agent, 41, King William Street, London, sought to recover commission for introducing investors for a certain patent for wireless telegraphy and telephony, and for specific performance of a clause in an agreement, dated February 11th, 1902, vesting in the plaintiff one-tenth of the world's rights in the invention. The agreement set out that in consideration of the plaintiff introducing a person or persons who should invest a sum of £500, the defendant undertook to pay 20 per cent. commission on the cash, as and when received, on that or any other larger and smaller amount which he might accept, and to vest in plaintiff 10 per cent. of the whole world's rights in the invention, the commission only to hold for a period of seven days. The plaintiff alleged that, in pursuance of this agreement, he introduced Dr. Richardson and Mr. Holt. The agreement was only signed by Johnson for the Tonophonic Syndicate in which plaintiff suggested all the defendants were included. The statement of claim alleged that Johnson accepted certain moneys from the gentlemen introduced by the plaintiff, and he claimed an account. The defendant Johnson, in his defence, said the agreement was only to hold good for seven days, and that he did not agree on behalf of the other defendants. The money was not invested within seven days, and while it was in contemplation that a sum of £500 or thereabouts should be found, the sum actually obtained through the plaintiff's introduction did not exceed £200. He further pleaded that under the circumstances the provisions were wholly unreasonable, and that specific performance should be refused on the ground of hardship. The other defendants denied that they had any part in the agreement, one of them adding that the Tonophonic Syndicate was not a registered company, and had no legal existence, but was merely a pseudonym invented by Johnson.

COUNSEL argued that it could not be contended that the money should be actually invested within seven days. Plaintiff, in bringing about the introduction in that time, had fulfilled his part of the agreement.

Evidence was given by the plaintiff, who said experiments were carried on for some months, and that apparatus was fixed up in Dr. Richardson's conservatory. He produced letters from Mr. Johnson, in which he said that the "instrument was working beautifully." Plaintiff wrote repeatedly for his money, but without result. Johnson invited him to a board meeting of the Invention's Proprietory Syndicate, who, he said, were the same people as the Tonophonic Syndicate, and four other defendants were present at the meeting. He was told there was not enough money to pay him the cash portion of his commission, and they offered him something not equivalent to 10 per cent. of the world's rights. There was no dispute as to the agreement.

Mr. ARTHUR THOMAS METCALFE JOHNSON, the first defendant, said he was the inventor, and with Mr. Guyatt, who was another defendant, patentee of an invention for wireless telegraphy. He advertised for £500 capital, and so got into communication with the plaintiff. Mr. Holt, introduced by plaintiff, put in £50, and subsequently wanted the money back, and Dr. Richardson provided another £50, which he had since increased to £123. He had only undertaken to use his best endeavours to raise £500. What he actually paid had been used for patent fees and experiments. The patent rights had now been assigned to a company.

His LORDSHIP, in giving judgement, said the plaintiff had not carried out his agreement, the foundation of which was the introduction of £500, and there must be judgement for all defendants with costs.

NEALE *v.* EAST HAM URBAN DISTRICT COUNCIL.

MR JUSTICE RIDLEY, sitting with a special jury on 17th inst., heard an action by Henry Neale, cycle maker and repairer, against the East Ham Urban District Council for damages for personal injuries. Plaintiff was riding outside one of the electric trams owned and worked by the defendant Corporation, when the overhead wire snapped, the loose portion flew back, striking plaintiff and burning his cap and shoulder, and the iron arm, released by the breaking of the wire, jumped back and struck him on the head and shoulder. When he got home he was taken violently sick and had to have medical advice. Through an accident several years ago the sight of plaintiff's left eye had been slightly affected, and since the accident in question in the present action the right eye, which had always been strong, had been rendered almost useless, and his sight had ever since being going from bad to worse.

The defendants denied negligence, and pleaded that the injuries, if any, were caused by inevitable accident.

The jury returned a verdict for the defendants.

His LORDSHIP entered judgement accordingly, and ordered money paid in to be paid out of Court.

THE ANNUAL DINNER OF THE GENERAL ELECTRIC CO., LTD.

ON Saturday last the fifteenth annual dinner of the General Electric Co., Ltd., took place at the Trocadero Restaurant, Mr. Max Byng being in the chair. There was a large attendance of members of the staff, in addition to the company's guests, the latter including central station engineers, consulting engineers, and numerous representatives of the electrical manufacturing and contracting industries, &c., many of whom had travelled considerable distances in order to be present. The catering was irreproachable, and the function passed off with the customary success.

After the loyal toasts had been duly honoured, to the satisfaction of the toastmaster, the chairman referred to the absence of Mr. Gustav Byng, who had just returned from Egypt that day, much benefited in health, but too late to preside at the dinner. Mr. Byng then addressed the staff at some length on the subject of "Details," taking for his text the proverb, "Penny wise and pound foolish." (We cannot help thinking that the chairman had in his mind the converse proverb, "Take care of the pence, and the pounds will take care of themselves.") The company, he said, employed 4,500 men, women and others, and a staff numbering 1,175 members to look after them. The salaries of the latter amounted to £60,000 per annum—a sum which raises in our mind the question whether office boys are included under the head of "staff"—whilst the wages bill was £240,000 per annum. When the business was a small one, the directors gave personal attention to the details; but since it had attained enormous dimensions, they could no longer do so, and were obliged to delegate these duties to their staff. Exhorting the latter to attend not only to their more obvious duties, but also to the most minute details, he eulogised their high qualities and proposed the toast of their health.

In reply, Mr. A. Brooker declared that the directors were the cleverest lot going, as was evident from their excellent choice of staff. The latter should all pull together to advance the interests of all—including the directors. Attention to details was the essence of success. He referred to certain bad standards which had been set up as precedents by foreign manufacturers, but was somewhat hampered by interruptions, which marred a good speech.

Mr. R. Dumas also replied, and referred to the importance of attention to detail in dynamo construction. At Witton Works, two 1,000-KW. sets were to be tested on the Hopkinson method on the following day. Many of their visitors at Witton seemed to be surprised at the unsuspected magnitude of those works.

Mr. Hirst, who was received with acclamation, gave a humorous review of the year's doings—interviewing the mothers of budding geniuses, who only wanted a start, engineers who were out of work because the staff had been reduced at their last place, and inventors of marvellous storage batteries; considering municipal specifications for 10 lamps and 2 lb. of fuse wire, with wonderful conditions attached, and so on. His last year's lecture on "Tact," he said

had borne excellent results. Confidence between employer and employed was essential to the conduct of so large an organisation, and this they possessed, for only about two members of their staff had written agreements, and those two would probably prefer to be without them when they knew the company better. While the directors had had to delegate details to their staff, they were not idle; Mr. G. Byng's political efforts, for instance, were based on the welfare of the G.E. Co. It was absolutely necessary to study these economic and political questions. He claimed the support of the representatives of railways, telegraphs, &c., who were present, on behalf of British industries, and proposed the toast of "The Guests," coupling with it the names of Mr. W. E. L. Gaine, who from the first had recognised that a concern possessing a monopoly had public duties to fulfil; Mr. Philip Dawson, who was going to generate electricity from ozone on the south coast, in order to propel trains from London to Brighton; and Mr. Councillor J Irwin, chairman of the Electric Lighting Committee of the Dublin Corporation, a post calling for quite exceptional qualities.

Mr. Gaine, in his reply, said he had had experience of the General Electric Co.'s work, which had done much to prove that Great Britain was not lagging behind foreign countries. If the telephone agreement was approved by Parliament, there would be a great development of this public service during the next few years before the Government took over the service. Mr. Dawson congratulated the staff and shareholders on the prosperity of the company, when others were complaining of hard times. He referred to two 1,000-kw. sets which the General Electric Co. were supplying to a company of American affinities, and to machines which they had made for the Admiralty, and spoke of the progress of the company as one of geometrical progression. Councillor Irwin stated that the trouble at the Dublin electricity works was in no respect the fault of the G.E. Co., which rose to the occasion, and possessed the confidence of the Corporation to such an extent that the latter had since placed an order for a 1,500-kw. set with the company. That set was already running on the town load. Theoretically, he was a Free Trader, but, unfortunately, that system had not worked out to the best advantage.

Mr. Medhurst, in proposing the health of the directors, stated that, thanks to the importance of the G.E. Co.'s operations, Mr. Hirst had been called upon to give evidence before the Tariff Commission, on which his lucid exposition had made a strong impression. However good Free Trade might be in theory, it was not enjoyable in practice. The G.E. Co really provided livelihood for a population of 25,000 souls, whose wants again gave employment to others. The prosperity of the country had been built up by manufacturers, who of all men were in the best position for doing good to the community. He hoped to see Mr. Hirst in Parliament ere long. The name coupled with the toast was that of Mr. Bevis, who, in reply, dwelt on the industry of the directors, whose hands were full of work.

Lastly, Sir R. Awdry proposed the health of the chairman, who briefly replied.

An excellent entertainment was provided, consisting of a programme of music, performed by the Universal Orchestra, and including the General Electric Company March; and items contributed by Messrs. Arthur Prince, Harrison-Hill, Byrd-Page, and Harry Hall As we have said, the function was highly successful. If, however, we may offer a suggestion for the still greater success of this popular occasion, it is that a discount of 50 per cent., or more, be allowed off the oratory of the evening. Seeing that the majority of those present were invited guests, was the occasion quite an appropriate one for preaching to the staff? The result was that the talented performers who had been engaged were obliged to follow one another in quick succession, and the entertainment, we believe, scarcely terminated by midnight.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Homopolar Dynamos.

The abstract of Mr. J. E. Noeggerath's paper in your issue of February 10th was very interesting reading, also the other articles and letters on the same subject which have appeared lately.

The homopolar dynamo seems to be getting more attention paid to it than in the past. It was neglected in favour of the commutating machine—an alternator at heart—which is not so limited in its field of application, in much the same way as the steam turbine was neglected for the reciprocating engine. Now that the steam turbine is so perfect, the homopolar dynamo has a much better chance of being properly developed. The chief difficulty with such machines seems to be the want of a really efficient moving contact. Improvement in the quality of iron would help, by allowing a greater flux density in the parts enclosed by the collecting rings, thus keeping the diameter of the rings smaller. I was agreeably surprised to observe the friction curve (fig. 13) of the article.

Some years ago, I devised and constructed a homopolar dynamo with a double disk armature (fig. 1), built up of 24 segments and 12 pairs of collecting rings. It gives 12 volts at 750 revolutions or 24 volts at 1,500 revolutions (the F.M. winding being divided in two). There is no difficulty in getting it to excite. There was considerable end thrust, which gave trouble, but this was overcome by carefully adjusting the position of the armature.

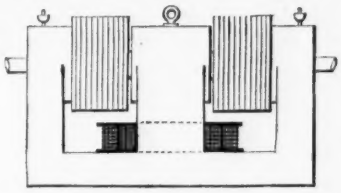


Fig. 1.

Fig. 2 is one of the armature segments. Fig. 3 is the armature showing the position, in black, of the contacts of the rings with the segments. Each ring is connected with two opposite segments.

Fig. 2

The present brushes are flexible bands sliding in grooves in the rings, and having about 90° arc of contact. The 12 generating units of the armature, each consisting of two segments and two rings, are all connected in series through the brushes and stationary conductors.

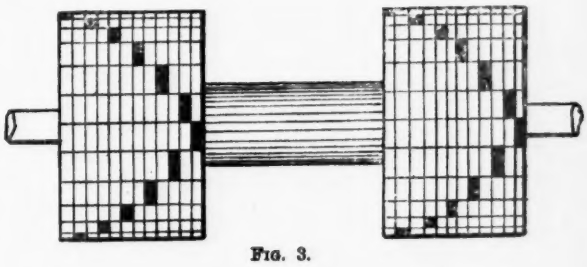


Fig. 3.

In 1897 I took out an English patent, No. 23,192, for a homopolar dynamo. One form of the dynamo had ring collectors, fig. 4. This form of the machine is of much the same type as the dynamo described by Mr. Noeggerath, and shown in fig. 5 in your article. It has a solid armature, and is provided with armature and field magnet conductors in slots or tunnels close to the middle air-gap, fig. 4. The

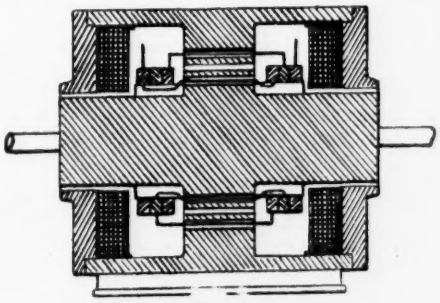


Fig. 4.

field magnet conductors are primarily for connecting the generating or armature conductors in series through the brushes and rings.

The following extracts from the patent specification show other uses, and why the field magnet conductors are placed so near the air-gap. "If any of the magnetic flux be caused to rotate by reason of the rotation of the armature, then such flux cutting the return (*i.e.*, field magnet) conductors

will set up an E.M.F. in such conductors in the opposite direction to that of the E.M.F. in the generating conductors; such E.M.F. would help that of the generating conductors, when the generating and return (*i.e.*, F.M.) conductors are connected by means of a collector (ring) and brush." Later it is stated "armature reaction is therefore neutralised by the current flowing in the return conductors, while in close proximity to the generating conductors, and in the opposite direction to that of the current flowing in them."

In this machine (fig. 4) it was considered sufficient to connect several armature conductors, equally spaced, to each ring, to do away with the trouble due to the currents changing direction in the ring when flowing to the brush or brushes. A dynamo of this type could also be used as an alternating current motor, series wound, with the necessary modifications. The voltage of the applied current being reduced to any suitable value by a transformer, one pair of rings only would be required.

In a search made some years ago I came across several British patents of homopolar dynamos, amongst them the following, which would perhaps be interesting to some readers of the REVIEW:—No. 3,134 (1878); see also "Electricity in the Service of Man," A. R. Urbanitzky, p. 308 (1893); No. 4,717 (1882); No. 5,926 (1883); No. 2,028 (1883); No. 3,115 (1883); No. 3,282 (1884); No. 11,244 (1884); No. 3,183 (1886); No. 8,459 (1889); No. 85 (1889); No. 17,108 (1890); No. 23,192 (1897).

Archd. H. Finlay.

Holywood, co. Down.
February 14th, 1905.

Batteries with Reversible Boosters.

We notice in your issue of February 10th a communication signed "P. B. O." in connection with batteries with reversible boosters. A number of questions are asked, and we beg to inquire whether you will kindly give us space in your columns to reply.

1. Highfield reversible boosters may readily be left alone by themselves all night on a comparatively light load, without attention. This is frequently done in many small stations. The practice is not perhaps to be recommended as a general thing on the principle that running machinery should always have an attendant, but as far as we know, no ill results have ever obtained where Highfield boosters have been left operating alone at night in this manner.

2. Provided the generators are not connected to the line the battery can readily be discharged without the booster working, or even when the generators are connected to the line, provided end cell regulating switches are installed.

3. Balancer booster combined sets on the Highfield principle are frequently installed without complications or difficulties of any kind. There are many of these at present in successful operation.

4. Charge and discharge recording ammeters provide a ready means of checking and comparing at stated intervals the amount of ampere-hours stored in the battery.

5. The heavy pressure battery suggested would not be satisfactory, as it would only supply current for one side of the line.

6. The arrangement shown would not give satisfaction, for the same reason that the effect of the battery would be only on one side of the line.

We quite agree, however, with the editors' comments. There is no necessity to adopt the three-wire system for the lighting of small towns.

The Chloride Electrical Storage Co., Ltd.,
E VAIL STEBBINS, *General Manager.*

Clifton Junction, *February 16th*, 1905.

Destructors and Electricity.

I have read with interest the letter by Mr. Frank Watson on the subject of "destruction," but think he has omitted a most important factor, *the cost of up-keep*, as on this depends to a large extent the final cost to the ratepayers, who sometimes in deciding on the selection of the lowest tender, let themselves in for an ever-increasing and endless expense, whereas, if those responsible had studied the designs of the various plants offered, and made inquiries, not from the makers, but *users* of the various types, they would have been spared a lot of expense, as well as frequent shut downs, during which time the plant cannot be fully at work.

Anyone interested in this point, as well as the actual cost of labour (not what may be the "promise" of the maker), cannot do better than refer to the useful tables given in the *Electrical Times* of March 3rd, 1904, and November 24th, 1904, of two London installations that have been much boomed, with, I think, little to back them up. It will be seen by anyone who refers to the above mentioned tables, that at Fulham during the year ending March 31st, 1903, the cost of labour was 18·9d. per ton of refuse burned, or a total cost per annum of £2,378, whilst cost of up-keep was £344, or 2·7d. per ton of refuse. In the second case, that of Hackney, the total labour cost was £3,611, or 22·1d. per ton of refuse destroyed, and up-keep £467, being 2·9d. per ton of refuse.

This does not strike one as so very worthy of comment.

Careful Investigator.

Engineer v. Contractor.

The wiring contractors who style themselves electrical engineers cause me to forward you the following illustration of their mistake.

This conversation by telephone actually occurred at a generating station not a 100 miles from Bolton.

Contractor: Hello! is that the generating station?
E.-in-C.: Yes.
Contractor: Well, our lights are very low, they are giving no light at all.
E.-in-C. (facetiously, knowing the contractor): Perhaps your lamps are burned out or your installation requires testing.
Contractor (spluttering audibly): Nothing of the kind, you have got your pressure low.
E.-in-C.: You are mistaken, the pressure here is all right.
Contractor: It can't be—you must have got your engines running too slow!!!
E.-in-C.: I'm afraid you don't know what you are talking about—good night. Various sounds heard as receiver is replaced.

E.-in-C.

Arc Lighting in the City.

Your correspondent "Observer" made very true remarks last week on the above subject.

Those conversant with prominent English manufacturers of arc lamps need no assurance that the City lighting authorities had no cause to place their trial order for flame arcs to illuminate the very heart of the Empire, with manufacturers of German lamps.

Therefore it appears most regrettable in this particular instance that British manufacturers had not the initiative, or push, to place their home manufactured articles of approved make to the fore. At least, this is not a case of waiting for Protection; the "wake up" policy is surely lacking.

Thanking you, in anticipation, for this insertion in your columns, to show that a fault is best overcome by remedying the defect.

P. H. E. E.

On Dumping.

I have been interested as well as amused by reading "Fiscalitis," an apocryphal conversation by A. Le Strange. How far his figures, and therefore his arguments, are correct I have no means of ascertaining; but there is one point regarding "Dumping" which I have not seen advanced, even in serious discussions, and I think it is one of great importance.

Freeth states ironically as follows:—"A paltry quarter of a million is building up the American electrical industry and ruining the British in which there is a capital of about 40 million pounds invested." Freeth is probably quite right; but can he say how many tenders the American manufacturers and their agents have sent in to British purchasers during the same period? Tenders which have not resulted in orders to the Americans owing to British manufacturers reducing their prices to meet this unfair competition, and, in consequence, losing money on the contracts. It appears to me that the damage done is by no means limited to the value of the machines dumped; but it is probably 20 or 30

times as great. Information of the nature described is difficult to obtain; but I think some of our consulting engineers, or corporation electrical engineers, could give figures which would shed a strong light upon this matter.

W. Arthur Ker.

Paisley, *February 20th*, 1905.

Nodon Patent Electric Valves.

Referring to Mr. Isenthal's communication in your correspondence of last week, I would like to say that the operation of starting the Nodon valve is very simple, only occupying a few seconds, and is similar to that of starting a motor.

I would also like to add that there is a considerable difference between an ordinary aluminium cell, and the Nodon valve. The theory of the former has been known for many years, but the latter was only discovered comparatively recently.

With regard to Mr. Wolff's letter, the advantage of using a coil of high self-induction in the direct current circuit would only be slight. There is no reverse current when charging a battery, and the alternating current may be switched off and no current will flow back from the cells.

With single cells the current may be intermittent, but it is usual to use four cells, and there is practically no limit to the E.M.F. which may be employed, one valve consisting of four cells being allowed for every 140 volts alternating. The cells are not, however, connected up in series, the diagram of connections being given in Mr. Boot's article.

Harry Snowdon.

London, E.C., *February 21st*, 1905.

Self-testing Installations.

I was very much interested in the subject matter contained in the abstract of the paper read at Glasgow by Mr. W. W. Lackie, which appeared in your current number. This matter of current leakage is, without doubt, most serious, and this is so fully handled by Mr. Lackie that further comments from me, in this direction, are unnecessary. I should like, however, to explain that I have an instrument in my office, which has been perfected and patented quite recently, fulfilling all the requirements Mr. Lackie, in common with many other gentlemen in the electrical profession, desires, viz., a means by which an electrical installation is continuously self-testing, as far as the insulation of such is concerned. The instrument mentioned is simplicity itself, remaining inactive whilst the service maintains a good standard of insulation, and coming into activity, without disconnection of current supply, whenever leakage occurs on any part of the *consumers' distribution only*. An important point in its application is that no connection to earth is required, except through a leakage set up, to bring the instrument into operation. It will give indication of a fault, beyond the indicator itself, by means of an alarm bell, lamp or similar method, or could, automatically, cut out a dangerous circuit. I thought that perhaps, in view of Mr. Lackie's paper, and the opinions appearing lately in the daily Press, the information I send might have interest for you, and such proving the case, you might consider whether your readers would be likely to have interest also through the medium of your "Correspondence."

I should be most pleased to furnish any further information or particulars, or give a view of the instrument under working conditions, if you or any one so desired.

J. W. Manley.

Eldon Street, London, E.C.,
February 21st, 1905.

To Charge Engineers.—We have received some names of engineers willing to take part in the deputation which, it is suggested by Mr. A. Davey, shall meet the council of the "Association of Engineers-in-Charge" to discuss the terms of membership &c. We have communicated these to Mr. Davey, and have no doubt that, if a sufficient number come forward, the proposed meeting will be arranged at an early date.—Eds. E.R.

PARLIAMENTARY.

During the past 10 days a very large number of petitions have been deposited in the Private Bill Office against many of the electrical Bills which are to come under consideration during the present Session. To give a full list of the petitioners would fill much of our valuable space, and it would not afford very interesting reading, for it would be a mere catalogue of names, and nothing more. In the case of the now much-discussed Bill of the Administrative County of London and District Electric Power Co., the number of petitions has been growing from day to day, until, as we write, we believe that over 100 objections have been filed. The other power proposals, promoted by the existing London electric lighting companies, affecting the metropolitan area are also the subject of much opposition, though the petitions are naturally not so numerous as in the case of the Administrative scheme. The Central London, North-East London, Great Northern, Piccadilly and Brompton, Hammersmith, City and North-East London Railway schemes, the L.C.C. and L.U.T. Tramway Bills are also the subject of much opposition. The other Bills concerned in these petitions are: Bolton Corporation; Weybridge and Walton-on-Thames Electric Supply; Wigan Corporation; Aberdare Tramways; Accrington Corporation; Andover Lighting and Power; Baker Street and Waterloo Railway; Metropolitan Electric Tramways; Cork Junction Railways; Croydon Corporation; Dublin United Tramways; Edgeware and Hampstead Railway; Heckmondwike Improvement; Rhondda U.D.C.; Shropshire and Worcester Electric Power; South Wales Electric Power Co.; Hastings Tramways; Metropolitan Electric Supply (Acton District); Metropolitan Railway; Mexborough and Swinton Tramways; Southend and Colchester Light Railways; South Lancashire Tramways; Wellingborough and District Tramroads and Electricity Supply; Blackpool Improvement; Oldham and Saddleworth District Tramways; Shepton Mallet Gas Co. (Electric Lighting); Blackpool, St. Annes and Lytham Tramways.

The London County Council (General Powers) Bill is being opposed by companies supplying energy in the county; also by electrical engineers and contractors in the County of London.

BUSINESS NOTES.

Cape Town Exhibition.—We learn that a gold medal has been awarded to Messrs. Richard Hornsby & Sons, Ltd., for the Hornsby-Akroyd oil engines, shown at this exhibition.

Automatic Point Controller.—A new form of automatic point controller, which can be brought into operation by the driver at will, has been devised and patented by Mr. Edward Cross, borough electrical engineer, Rotherham, and is being experimentally adopted on the tramways of that town. The essential features of the device are as follows:—In the centre of the track, before and after the points, are fixed two road boxes, each covered by a hinged lid, normally closed. The lids have arms cast on them, which, when the lids are raised, come into contact with levers which actuate the points. An electro-magnet is carried under the centre of the truck, and is provided with lugs on the lower face. When the magnet is energised, as it passes over the road box it raises the lid of the latter into the vertical position, and one or other of the lugs on the magnet then engages with the lid; as the car moves on, it presses the lid further back and thus actuates the points. In passing over the second road box the operation is carried out in the opposite sense, the points and boxes being restored to their normal condition.

Trade Improving.—The monthly report of the Boilermakers' and Iron and Steel Shipbuilders' Society states that there has been a remarkable drop in the numbers out of work. The prospects of good trade are much brighter than any one, however optimistic, anticipated a few weeks ago. From nearly all the districts comes the news that trade is improving rapidly. In addition to the great improvement in the mercantile trade, there is a prospect of improvement in the work to be undertaken for the several navies of the world.—*Times*.

Trade Announcements.—Messrs. R. Waygood & Co., Ltd., state that their Newcastle address is now Royal Exchange Buildings, Grey Street, Newcastle-on-Tyne, Mr. A. J. Hurst being the district representative.

Mr. H. Bell has resigned the position of Metropolitan contract and sales manager to the National Telephone Co. in order to start business in conjunction with Mr. Stanley C. Russ, also formerly in the National Co.'s contract department. They will carry on business as telephone experts and contractors for all kinds of electrical work at Mansion House Chambers, 11, Queen Victoria-street, E.C. We understand that Mr. Bell was in the service of the National Telephone Co. for 16 or 17 years, during which period he had been manager for several districts—West of England, S.E. Lancashire and South Wales.

The London Electrical Fittings Co., Ltd., of Roberts' Works, Hampstead Road, N.W., and 7A, Soho Square, W., wish us to state—in order to avoid any misunderstanding—that they are in no way connected with the Electrical Fittings Co., Ltd., of Conduit Street, W., and that their only addresses are as above.

Catalogues, Lists, &c.—We have received from the Armorduct Manufacturing Co., Ltd., 6, Farringdon Avenue, E.C., a copy of a neat pocket-book entitled "Armorduct Pocket Cost," 1905. It contains a complete catalogue of electric wires and cables, conduits and conduit accessories, and wiring sundries generally, in a convenient form, and in addition a diary for the year.

The Crypto Electrical Co., 3, Tyer's Gateway, Bermondsey, S.E., have issued a price sheet relating to a new small dynamo or motor which they have placed on the market.

From the Asphaltic Limestone Concrete Co., Ltd., 42, Berners Street, W., and Birmingham, we have received a pamphlet relating to asphalte and its uses; also an illustrated booklet on asphalte troughing for underground cables. This is nicely printed on art paper, and should be of interest to mains engineers.

Messrs. Oliver & Co., Cambridge Place, Burrage Road, Woolwich, have sent us a booklet on street lighting fittings. Bracket arms of various designs are illustrated, as are also incandescent and Nernst lamp fittings.

Messrs. Geipel & Lange, of St. Thomas Street, S.E., have issued a new list fully describing and illustrating the Vulcan watt-hour meter.

The Riehle Bros. Testing Machine Co., Inc., 1,424, North 9th Street, Philadelphia, Pa., have sent us a copy of a catalogue describing some of their U.S. standard testing machines, among which we note a Riehlé absorption dynamometer for high-speed motors.

Mr. Severin Senator, 17, Neue Winterfeldtstr., Berlin, has sent us a price sheet relating to the Tantal incandescent and the "Nernst" lamps.

We have received from the London Electric Wire Co., Ltd., Playhouse Yard, Golden Lane, E.C., a trade list appertaining to their cables (associated and non-associated) and wires for all electrical purposes, dynamo brushes, jointing materials, ebonite, etc.

Messrs. Mirrlees, Watson & Co., Ltd., Gresham House, Old Broad Street, E.C., and Glasgow, have sent us a well got up pamphlet describing their various types of condensing plant and the conditions for which each type is most suitable.

A pamphlet has come to hand from Messrs. Chambers, Scott & Co., Motherwell, N.B., dealing with their various electrically-driven winches. We have advocated the adoption of electric winches on ship-board, etc., and those interested might apply to the company for particulars of their machines.

The General Electric Co., Ltd., 71, Queen Victoria Street, E.C., have sent us a copy of a small booklet which they are just distributing, in which are illustrated special cheap lines of battery ringing telephones, etc., specially designed to meet the demand for cheap indoor and short distance use. The company have only included in this booklet accessories which are most suitable for use in conjunction with the instruments illustrated;

Intercommunication Battery Table Telephone.

it shows at a glance the particular class of material that should be used. A comprehensive set of diagrams is included, showing how to connect up the instruments in practically every possible manner. We illustrate a new pattern intercommunication battery table set, which is of neat and compact design, and very suitable for connection between different departments in factories, offices, etc. A wall set to work with the above is also illustrated in the list.

We have received from the Empire Roller Bearings Co., Ltd., 15, Victoria Street, Westminster, price lists and pamphlets relating to their well-known patents. The company have now put down special new machinery for producing improved and cheaper forms of roller bearing plummer blocks for shafting and trolley work.

The National Telephone Co., Ltd., Telephone House, Victoria Embankment, E.C., have sent us a revised edition of their catalogue of Metaphones, which is well illustrated and printed on art paper. As our readers well know, Metaphones are supplied by the company for use in connection with existing electric bell wires. Much information is given in the list, together with several diagrams of connections.

Messrs. Sessions & Sons, Ltd., Gloucester, have sent us a sheet drawing attention to their enamelled, plain slate and marble slabs. A speciality is made of these slabs for electrical work.

From Messrs. E. F. Moy, Ltd., Greenland Place, Camden Town, N.W., a price list has come to hand illustrating and describing Mordey's patent fuses, also one relating to their No. 56 distributing boards.

The Societe Anonyme des Manufactures de Cables, Accumulateurs et Appariels Electrique, Seneffe, Belgium, have sent us a well-printed catalogue of their cables and wires. As is usual with all cable-makers' catalogues, a host of sizes, weights, &c., of cables and wires to suit all purposes is given.

We have received from Messrs. Siemens Bros. & Co., Ltd., York Street, Westminster, further diagrams of connections for their generators and motors, and sheets showing outline drawings, dimensions, &c., of their electrical machines, which also give tables of gearing ratios. Messrs. Siemens have also sent us a pamphlet describing an instrument (Brougham's patent) for ascertaining a ship's position at sea by account; it is styled the "Deadreckoner," and should be of considerable interest to navigators. The method of using the instrument is fully described in the pamphlet.

The Western Electric Co, North Woolwich, and 171, Queen Victoria Street, E.C., have sent us copies of their price lists of A.C. fan motors, enclosed arc lamps, D.C. circuit-breakers, sewing machine motors, and motor-driven grinders. All of the lists are enclosed in a neat binder.

We have received a pamphlet from Messrs. Johnson and Phillips, Old Charlton, S.E., illustrating their various types of switchboards.

Messrs. W. T. Henley's Telegraph Works Co., Ltd., Blomfield Street, London Wall, E.C., have sent us a copy of their new price list of rubber insulated wires and cables, flexible cords, &c. The list is divided into two sections, one relating to association and the other to non-association wires, &c. These new non-association wires, the company point out, differ from the association wires only in the quality and cost of the india-rubber employed, and are recommended where the high standard of association wires is not deemed to be necessary.

We have received from Messrs. C. A. Vandervell & Co, Chapter Works, Willesden, N.W., a catalogue of ignition accumulators for motor-cars, &c., and automobile lamps and accessories.

Mr. F. J. Down, 6, Crutched Friars, E.C., is introducing a new device for preventing wear on gears.

The Aron Electricity Meter, Ltd., 114, Union Street, Borough, S.E., have sent us a copy of a pamphlet on their new Aron alternating current motor meter. The instrument is described therein and instructions for fixing and starting are also given. The G.E. Co., Ltd., 71, Queen Victoria Street, E.C., are the selling agents.

From the A.E.G. English Manufacturing Co., Ltd., we have received an illustrated catalogue of their various types of Nernst lamps.

Messrs. Thos. Parker, Ltd., Wolverhampton, have sent us a number of their art paper pamphlets, inserted in a self-binder, which enables them to be neatly kept for reference. Circular No. 1 contains details of belt-driven multipolar dynamos; No. 2, continuous current motors; No. 3, gives specification of two-pole dynamos and motors, open type, with single H.S. magnets, fitted with patent hinged pole tips; No. 4 describes the construction of a slow speed multipolar generator. Other pamphlets illustrate various machines, &c, made and installed by this company.

Messrs. Le Carbone, 17, Water Lane, Great Tower Street, E.C., have issued a trade sheet relating to their patent pigtail conections for brushes.

Ferranti Contracts.—The following orders have recently been booked by Messrs. Ferranti, Ltd:—

Newcastle and District E.L. Co., Ltd.—For their Close Works, c.c. lighting switchgear extension 500 volts, comprising 12 1,000-ampere feeder panels.

Bloemfontein Corporation.—Five kw. transformer, with switchgear, for arc lighting.

Paisley Corporation.—30-kw. rectifier and switchgear for arc lighting. (A similar machine has already been installed.)

East London Corporation, S.A.—Four 20-kw. single-phase air-cooled transformers in expanded metal cases.

Marylebone.—A number of regulating rheostats of different sizes and types, ordered through Messrs. C. A. Parsons & Co.

Brush Contracts.—The following new contracts have been booked by the Brush Electrical Engineering Co.:—

Five double-deck car-bodies with radial trucks and Brush motor equipments, for the Middleton Electric Traction Co.; 170 car-bodies and trucks, ordered by Messrs. J. G. White & Co., for Belfast; two double-deck car-bodies with Brush trucks and B.T.H. equipments, for the Keighley Corporation; nine radial-action trucks for new tramcars for the Rochdale Corporation; and tramways overhead equipment (£4,217) for the Erith District Council.

The Caron Low-Tension Ignition Device.—We are informed that the Watkins Patents Syndicate, 157, Fenchurch Street, London, E.C., have been appointed British Agents for the Caron low-tension ignition device, illustrated in our issue of the 10th inst.

Dissolutions and Liquidations.—Mr. A. F. Whinney, of 32, Old Jewry, E.C., was on February 3rd appointed liquidator (with a committee of inspection) in the case of the Sir Hiram Maxim Electrical and Engineering Co., Ltd.

Creditors of the Electrical Fittings Co., Ltd., are to send particulars of their debts, &c., to Mr. J. D. Pattullo, the liquidator, by March 31st, as announced in our advertisement pages to-day.

The National Electric Traction Co., Ltd., is winding up voluntarily, with Mr. Leslie Morse, 79, Queen Street, E.C., as liquidator.

A meeting of the Electro Institute, Ltd., is to be held at 8 and 9, Great James Street, Bedford Row, W.C., on March 20th, to hear an account of the winding up.

Messrs. J. Bontch and C. B. Heaviside (Heaviside & Bontch, electrical and mechanical engineers, 14, Neville Street, Newcastle-on-Tyne) have dissolved partnership. Mr. Bontch will attend to debts.

A meeting of the Bath Electric Manufacturing Co., Ltd., will be held at Bristol on March 24th to hear an account of the winding up from the liquidator, Mr. A. C. Comley.

Messrs. G. Brearley, J. Horrox and J. B. Horrox (Brearley, Horrox & Co., mechanical and electrical engineers, 90, Back George Street, Manchester), have dissolved partnership. Messrs. J. and J. B. Horrox will attend to debts, and will continue the business as Horrox & Co.

Bankruptcy Proceedings.—At the London Bankruptcy Court last Monday, Mr. Walter Boyle, Assistant Receiver, presided at the first meeting of the creditors of Alfred Ernest Parker, who some three and a half years ago started the Electrical Fittings Co., at 38, Conduit Street, W., and resides at Priory Court Mansions, West Hampstead, N.W. It appeared from the proceedings that the debtor was for some years a partner in the building firm of Patman and Fotheringham, whose business was four years ago converted into a limited company, with a capital of £100,000, the shares being equally divided between himself and an elder brother. Nine years ago, in conjunction with a Mr. Raynor the debtor started a small company styled Wells and Co., and put into it about £1,500. That business was converted into a limited company three years ago, under the style of Wells, Rayner, and Co., Ltd., the debtor taking shares therein for his interest in the old firm. Then, seven years ago, he joined the board of the Fireproof Partition Syndicate, Ltd., and invested between £3,000 and £4,000 in it. He has now no interest in Wells, Rayner, and Co., Ltd., nor is he now on the board of the Fireproof Partition Syndicate. He has put £12,000, at different times, into the Electrical Fittings Co., to obtain which money he has assigned his various share interests to his wife and a Mrs. Traill. The business was in August, 1904, converted into the Electrical Fittings Co., Ltd., with a capital of £15,000. In return for £12,000 shares he handed over the business and its assets as from June 1st, 1904, to the new company, which undertook to pay all the liabilities then outstanding. The company failed to discharge that obligation, and the creditors came down upon the debtor, to which fact he partly attributes his present position. The company is now in liquidation, and the debtor informed the Chairman that the creditors would receive about 5s. in the pound, so that the shares were worthless, as no return could be made to the shareholders. The debtor has also stated that when he handed over the business to the new company there was a free capital of £2,000, besides the stock, plant, furniture, catalogues, and goodwill; further, that he is at a complete loss to understand the collapse of the company. In March, 1904, he agreed to purchase for £500 a one-half interest in the Arc Lamps, Ltd., at 38, Conduit Street, when the company was formed, and he holds £100 fully paid shares in that company. He attributes his failure to bad management on the part of the Manager of the Electrical Fittings Co., who was subsequently Managing Director of the Electrical Fittings Co., Ltd.; also to his brother's failure to discharge his liabilities in connection with Patman and Fotheringham, Ltd. No statement of affairs has been lodged, but the debtor roughly estimates his liabilities at between £3,000 and £4,000. The meeting was adjourned for a fortnight to enable the accounts to be filed, and to give the creditors an opportunity to elect a trustee and committee of inspection, the public examination of the debtor being fixed for March 17th. Mr. Belfrage (Belfrage and Co.) attended the meeting on his behalf, and intimated that no proposal was contemplated.

At Burnley County Court, on February 16th, Robert Foster, electrical engineer, formerly trading in partnership with a Mr. Baker, under the style of Foster and Baker, at Nelson and Burnley, applied for his discharge. The Official Receiver (Mr. Plant) stated that Baker's discharge had been suspended for two years, or was granted subject to judgment for £50 being entered against him. Under the failure a dividend of 2s. 1½d. had been paid on proofs amounting to £1,349. Foster's separate estate showed liabilities amounting to £796, and no assets. This was money lent by relatives and put into the business. When Baker became partner, in January, 1899, Foster stated that the concern was perfectly solvent, and that he had put into the business altogether about £1,000. There was nothing to show that this was so, and the Official Receiver questioned whether he had put the money into the business. Foster's conduct had not been altogether satisfactory. On behalf of the debtor it was urged that Foster did not wilfully misrepresent the position of the business to Baker, who was a practical man and understood the business. Judge Bompas said he would defer his decision owing to the nature of the Official Receiver's report, in order that he could look carefully into the case. If there was gross misconduct on the part of the debtor he would not pass it over, but if he thought it was merely carelessness, he would probably treat Foster as he did Baker.

A first and final dividend of 4 11-16d. in the pound is payable on February 23rd, at 117, St. Mary Street, Cardiff, *in re* Thomas Williams, electrical engineer, Llandaff.

At Liverpool Bankruptcy Court, on February 16th, the further examination of William and Edward Sumner, electrical engineers, was adjourned to March 2nd for the completion of accounts ordered by the Court.

American Exports of Electrical Machinery and Appliances.—Returns just to hand show that there was a falling off last year in the exports of electrical appliances from the United States, the shipments having attained a value of only £872,798, as compared with £950,309 in 1903. On the other hand, the aggregate exports of electrical machinery increased from £1,020,900 to £1,335,153. Hitherto England has headed the list as being America's best customer for electrical machinery, but in 1904 we occupied only second place, with a total of only £244,120, as against £344,836 in 1903. The largest shipments were made to Canada, which took £322,314 of the total, as against only £276,039 in the earlier year. One of the most noticeable features of the return is the increased shipments to Japan, which, notwithstanding the war, advanced from £66,517 in 1903 to £236,538 last year.

Book Notices. — *The Inventor's Guide to Patent Law and the New Practice.* By James Roberts, M.A., LL.B., of the Inner Temple, Barrister-at-Law, London. This book, according to the introduction, "is written for those who require a simple explanation of the law and rules governing the grant of patents in the United Kingdom, and information as to the proper manner of protecting their inventions so as to avoid the risk and consequences of premature disclosure of their ideas." It is stated to be complete in itself, but it contains references to a large number of text-books relating to the law of letters patent, and in particular references to a larger work by the same author, *e.g.*, "The Grant and Validity of British Patents for Inventions." Like other works on patent law published this year, it has for its principal object the explanation of the Patents Act, 1902, and the rules relating to the "official search," which were published in January of the present year. The text of the Act of 1902 and the rules above referred to are set out at the end of the volume. It is often a relief to take up a legal text book which merely states the law without troubling the reader with a host of references. This is one of the attractions of the present volume, and if the reader requires further information, and happens to possess one or other of the larger text books on the law of patents, he will find this volume most useful as a guide. The author has the happy knack of giving illustrations to his various propositions, which serve to impress the truth and meaning of his propositions on the reader's memory. Thus, in order to impress upon the inventor the necessity of giving adequate directions for a patent, he cites the following case:—"A patentee claimed a dye which was substantially pure. In his own experiments he happened to use an iron vessel, the iron of which combined with acid that was set free. If an enamelled vessel were used, the process would not produce the pure result claimed, but the patentee did not know of this fact. Enamelled vessels were frequently used in similar operations. The patent was held invalid for insufficiency of directions." Although the work appears to be primarily designed for inventors, it will be of considerable value to patent agents and lawyers who desire the latest information upon what is one of the most technical branches of the law.

The Inventor's Adviser and Manufacturer's Handbook to Patents, Designs, and Trade Marks; being an Instructional Guide to the Commercial Development of Inventions, their Protection by Patents at Home and Abroad, and the Valuation and Disposal of Patent Rights, with a Treatise on Patent Law and Practice in Great Britain, Précis of Foreign Patent Laws, etc. By Reginald Haddan, Fellow of the Chartered Institute of Patent Agents. Sixth edition, 1905. Price 5s. London: Harrison & Sons, 45, Pall Mall.—We have had occasion to review many books of the law relating to patents, designs, and trade marks. Some of these works claim to be written for the behoof of legal practitioners, others for the guidance of inventors. The work now before us comes into the latter class. The original edition was "intended to supply inventors, manufacturers, and others interested in patents as property, with a full explanation of the causes which sustain, or detract from, the *value* of patented inventions"; the new edition is written on the same lines. We have no hesitation in saying that Mr. Haddan's work takes rank amongst the best books which have been published with the object of guiding the inventor through the intricacies of the patent law. One feature which, to our mind, enhances the value of the work may be specially mentioned. It is not easy to obtain advice or information as to the commercial value of a patented invention. Many a man is seized of a brilliant idea, which to his uninstructed imagination may be calculated to revolutionise an industry. It is obvious that before considering whether his idea is proper subject matter for a valid patent he should consider the question of its practical utility. Realising the importance of this consideration, Mr. Haddan very wisely devotes an introductory chapter to the "commercial aspect of inventions and patents." Under this head he deals with "the cost of obtaining provisional protections and patents" and the cost of obtaining foreign patents. Perhaps the most useful part of the introduction is to be found under the heading, "How to develop or negotiate property in patents and inventions." Here the inventor may seek, and we are confident that he will find, valuable assistance in selecting a method of developing his patent rights, whether by assignment, sale to a company, or in some other manner. The present edition was called for by the passing of a new Patents Act, 1902, under which important rules came into force on January 1st, 1905. The changes effected by this Act and the rules made are duly noted in the body of the work. In view of the fact that an English invention may require protection all over the world, it is in the highest degree important for an inventor to

be able to obtain information at a glance in relation to the patent laws of other countries. Mr. Haddan gives a short account of the patent laws in every country of importance. This part of the work is likely to be most useful to the would-be patentee, not only because it gives the principles of the patent law in these different countries, but because Mr. Haddan prints a number of forms, which will enable a patentee to make his application in the proper language. We can confidently recommend his work to all who are interested in letters patent for inventions.

The first number of the "Transactions of the Faraday Society," for January, contains a number of papers and notes recently read before the Society, dating from October last. The journal is well printed and produced, and, we hope, is the forerunner of many of its kind. It is to be had from the Society, 82, Victoria Street, S.W.; price 10s. 6d.

"Street's Newspaper Directory for 1905." London: Street's British, Foreign, and Colonial Advertising Office. 3s. 6d.

Manual of Electrical Undertakings and Directory of Officials. By E. Garcke. London: Electrical Press, Ltd, 37 and 38, Strand, W.C. 15s. net.—The 1905 edition of this invaluable office companion has been issued. This is the ninth year of publication and the work continues to increase in dimensions, notwithstanding the efforts that have been made to arrange the additional matter within the minimum of space consistent with convenience of reference. This year's addition of 200 pages brings up the total to 1,700. Some 2,400 undertakings are now particularised, their capital issued being close upon £267,000,000. The general information concerning both private and municipal works is again classified under five heads—(1) Electric Lighting, Power and Traction; (2) Telegraph and Telephone; (3) Manufacturing and Miscellaneous; (4) Directory of Directors and Officials; and (5) List of other electrical companies registered since 1856. Taking the returns as a whole, we find that they, as might be expected, reveal the effects of trade conditions from which no industry seems to have been exempt. An exception has to be made in the case of telegraphs and telephones. Thus the average return of the telegraph companies is 5·19 per cent., while in the previous volume the corresponding figure stood at 4·76 per cent. The telephone rate has likewise risen from 4·80 to 4·88 per cent. In the other departments, with the exception of electric lighting, there is a decline in the average rate of dividend or interest. In the electric lighting section, where the capital involved has increased from 20½ to 24 millions, the return remains at exactly the same figure as in the previous year—5·03 per cent. In the traction section the increase in capital is much greater—from less than 49 millions to over 61 millions—owing to some extent to the development of electric traction on railways, and there the return has fallen from 4·41 per cent. to 4·33 per cent. Considering the amount of fresh capital involved, and the effect which the depression in trade has had on tramway traffic generally, the slightness of the reduction is a sign of economical working. In considering the manufacturing results, allowance has to be made for the exceptionally large amount of unremunerative capital involved in one particular undertaking. The capital has risen by almost exactly 3 millions to £28,715,600, and the average rate of return has dropped from 5·85 per cent. to 4·97 per cent. A still greater decrease is shown in connection with the miscellaneous companies, which include all those not allotable to the other main divisions. These companies have, naturally, suffered more from the dulness of trade than the standard divisions; the capital has increased by only £670,000, and the return is 2·82 per cent. as against 6·49 per cent. Taking all the divisions together, the total average rate is 4·70 per cent. as compared with 4·95 per cent. There is a great deal of other statistical matter in the *Manual*, and there is again a section devoted to the main electrical events of the preceding year. We cannot afford space to mention all the matters of interest and value that appear in the work, but we ought to state that there are 44 special maps of urban and inter-urban electric tramway systems, and others relating to railways. Those who have accustomed themselves to the use of Garcke's Manual will straightway order their 1905 copy if they have not already done so. We are convinced that it is *the* indispensable work of reference to the electrical man, whether he be engineering or commercial in colour.

The Imperial Directory of Lighting and Traction for 1905 has been issued. It is edited and compiled by Mr. C. S. Vesey Brown, and its price is now 12s. 6d. net. It is published at 53, Long Acre, W.C. The book has been enlarged—which is only to be expected in view of the growth of the business it represents. There are now two main sections, one giving the usual statistical information relating to electric light and power systems, tramways and railways in Great Britain and Ireland, and the other containing particulars of similar undertakings in the British Colonies, Africa, America, Asia, Australia and Europe. One of the chief claims of the work is that it is a complete record for the whole of the British Empire from the point of view of electricity supply. There is a full and useful alphabetical section of officials connected with the different systems. Wherever obtainable, full financial information is given up to the end of the last complete financial year prior to the date of compilation. With this and other works, no one can say that the electrical industry is badly looked after in regard to statistical and directory publications.

"Mechanical Appliances, Mechanical Movements and Novelties of Construction." By Gardner D. Hiscox. London: Archibald Constable & Co., Ltd. 12s. 6d. net.

The Electric Lighting of Machine Tools.—Ever since the introduction of lighting by electricity, the problem of applying the light to machine tools and drawing boards, and for similar purposes, has been well to the fore, and has apparently found no satisfactory solution. Early attempts were made to apply electric lamps to folding brackets, but none of them were successful. The weight of the lamp and its lampholder caused trouble with the swivel joints, and there were difficulties with the flexible conductors. Aware of these facts, Mr. Henry Lea, of the firm of Henry Lea & Son, consulting engineers, Birmingham, has been experimenting for years in his private workshop, with various devices for properly lighting his lathe, vice, and carpenter's bench,

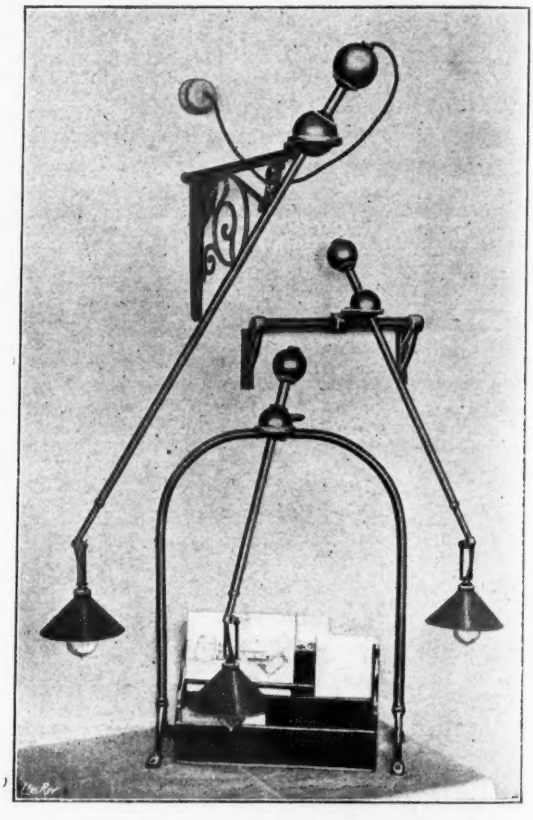


Fig. 1.

and has now brought out an invention which seems to possess many advantages. It consists of a tubular arm (fig. 1) suspended from a large ball, sunk deeply into a circular opening in a horizontal plate; the arm is capable of being moved in any direction to an angle of about 45° with the perpendicular, the motion being limited by the diameter of the lower edge of the hole in the plate. A prolongation

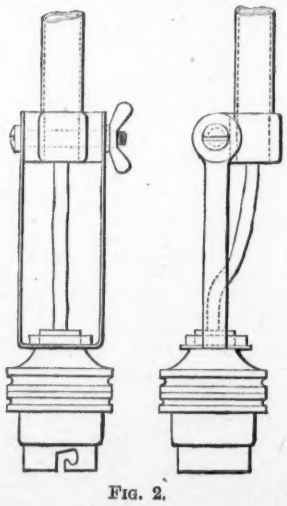


Fig. 2.

of the arm above the ball has a weight fixed upon it which balances the weight of the lower portion of the arm; hence the arm will stay in any position in which it may be placed. A short telescopic tube slides in and out of the lower end of the arm, and has a light spring frictional attachment to prevent its descent by gravitation. To the lower end of the telescopic tube, a lampholder with lamp and cardboard shade are attached, sometimes directly, and sometimes from a hinge pin, see fig. 2. There is enough friction between the ball and the plate to neutralise the varying leverage of the telescopic tube. The electric conductor, a length of braided

workshop lead, passes upwards through both tubes, and is connected, with a bold bend, to a wall socket above the fitting. As the conductor slides in and out of the tube, it simply forms a more or less bold bend. The fittings are at present made in four sizes, having total ranges of motion varying from 9 ft. 3 in. to 3 ft. That is to say, the lamp can be placed at any spot within a horizontal circle of the diameter stated, and it will remain in that position without tightening up any set screw, wing nut, or other locking device. One of these fittings has been in use for some time over a lathe at the Birmingham University. It has given great satisfaction, and we understand that the machine shop, pattern shop, and drawing office of the new University Buildings are to be fitted throughout with such fittings. The battens which support the countershafts form convenient fixtures for carrying the plates in which the balls rest. The fittings are made by Messrs. Player and Mitchell, of Cambridge Street, Birmingham.

A Useful Map of London.—We have received from Mr. Edward Stanford, of 12, 13 & 14, Long Acre, W.C., a map which possesses considerable value at the present time. It shows the whole London area, and by means of red and blue markings indicates the many projects which have been introduced in the present session of Parliament for metropolitan railways, tramways and miscellaneous improvements. In order to cover so much ground, and show with clearness exactly what areas and districts are affected under these numerous proposals, the location of proposed power stations, and so forth, the map has necessarily to be a very large one; indeed, it has been necessary to make it in two sections, so that it shall not be altogether unwieldy for reference purposes. The schemes which are shown in the map include the seven tube railway applications; the four proposals for electric power supply (the Administrative County area, the Central Electric Supply, the County of London Electric Supply, and the East London and Lower Thames); the L.C.C. tramway projects; also the intended works of the G.E., G.N., and G.W. Railway Companies, as well as the Metropolitan Pneumatic Dispatch, L.C.C. General Powers, and general improvements. The railways and tramways in operation, sanctioned and proposed are all included. Now that there is so much activity in Committee Rooms and in Parliament itself, the map promises to be of considerable service to anyone who is interested in the progress made with any of the schemes affecting the metropolitan area. The price of the sheets as before us is half-a-guinea, but they are supplied in a more convenient form, mounted to fold in a case, at 18s.

Paddington Electricity Exhibition.—We are informed that this exhibition, which is being organised by the Metropolitan Electric Supply Co. at the Queen's Road Baths, Bayswater, has met with a most gratifying response from the electrical trades. Practically the whole of the space has already been allotted, and the exhibits will be of a most interesting and varied character.

The British Fire Prevention Committee.—The tests next on the list are in respect to three wired glass casements, by Messrs. Pilkington Bros., Ltd., (being their third test); a 2½ inch partition, by the Adamant Co., Ltd., (being their second test); a partition by the Asbestic Brick and Tile Co., Ltd.; a concrete floor with broad flange girders, provided by Messrs. Skelton and Co.; and an automatic fire alarm system by the Danish Autopyrophone Co. The committee has just issued the report of the special commission which attended the Buda-Pesth Fire Congress. A report will be shortly issued on a 2½ inch plastic partition of Messrs. Gust and Co., also a report on three electro-glazed casements of the British Luxfer Prism Syndicate. The next series of tests is to take place on Wednesday, March 8th.

LIGHTING AND POWER NOTES.

Ashton-under-Lyne.—The T.C. has adopted the following revised scale of charges for energy. For continuous running motors: first 250 units per qr., 1½d. per unit; second 250, 1½d. per unit; next 500 units, 1·0d. per unit; all over 1,000 units per qr., ·9d. per unit.

Australia.—Kalgoorlie.—Terms have been settled between the Roads Board and the Kalgoorlie Electric Light and Power Corporation for giving the latter a concession to erect poles and cables in the district for street and house lighting. The Board retains power to terminate the contract for street lighting upon three months' notice. Street lighting charges are to be for 8 c.p., 6s. per month; 16 c.p., 9s.; 32 c.p., 15s.; 1,000-c.p. arcs, 55s. per month. These rates, however, are to be reduced by 1s. per month, provided more than 40 street lamps are put into use. For private lighting the rates are:—Up to 500 units per month, 7d.; 500 to 800 units, 6d.; over 800 units, 5d. Motive power, less than 300 units, 4d.; more than 300, and less than 600, 3½d.; over 600, per month, 3d. per unit. Motors over 2 h.p. may be charged at 15s. per h.p., flat rate. Discounts are to be allowed.

Barking.—The Thames Conservancy Board has agreed to give permission to the U.D.C. to lay two additional electric cables under the bed of Barking Creek.

Barnstaple.—The accounts of the Corporation electric lighting undertaking for the past year show a surplus of £292. The number of private consumers has increased from 159 to 219, and the public electric lamps from 42 to 95.

Bath.—The E.L. Committee has recommended to the Urban Sanitary Authority, that application be made to the L.G.B. for a loan of £10,000. Of this amount £7,000 is for further plant required to meet the growth of the demand for energy, and £3,000 for extensions to distributing mains, &c. In addition, the Committee states that for £900 the public arc lighting in the centre of the city can be improved.

In resolving what capital expenditure must be made to meet the annual growth of the undertaking, the Committee has not had recourse to Mr. Manville, its consulting engineer, but to the borough electrical engineer, Mr. F. Teague. The report states that the Committee does not propose to ask for Mr. Manville's assistance in specifying or carrying out any further extensions which may be found necessary.

Bedwellty.—We regret that the information contained in our note under this head last week was not correct. Messrs. Lewis & Fletcher, of Cardiff, the consulting engineers to the B. of G., inform us that the Guardians have not decided to take a supply of energy from the Tredegar Iron Co.

Bexhill.—An electrical exhibition is being held at the Kursaal under the auspices of the B.C., and has been organised by the E.L. Committee and Mr. W. T. Le Feuvre, borough electrical engineer, with the object of bringing before the local public the utility of electricity for motive power, heating and lighting, but principally to demonstrate its application to the former purposes. The exhibition was opened on Friday last by the Mayor (Earl de la Warr), and is to remain open until the 25th inst. The Mayor at the opening referred to the decision of the Council to let out electrical heating apparatus and cooking stoves on hire, and claimed that it was the first to take that step. Prior to the opening ceremony, an electrically-cooked luncheon was partaken of by the gathering on the invitation of the Mayor.

The following firms are represented at the exhition:—Mr. P. Hodgkinson, Bexhill, fittings, lamps, fans, radiators, &c.; Messrs. H. G. Matthews, Bexhill, electric light accessories, cooking utensils, &c.; Messrs. Veritys, electroliers, arc lamps and motors. Wooden electric fittings are displayed by Messrs. J. S. Henry, Ltd., motors, transformers, &c., by Messrs. D. Santoni & Co., Ltd. Heating and cooking apparatus are shown by Messrs. Isenthal and Co.; this firm has entered into an arrangement with the T.C. for the supply of various appliances on the hire system. The Reason Manufacturing Co., Ltd., London Electrical Syndicate, Ltd., Mr. L. Russell, Messrs. Cunningham, Sabin and Co., Messrs. Heath, Robey & Co., Messrs. Babcock and Wilcox, Ltd., Messrs. Elman Bros. & Co., and Messrs. J. L. French and Co. also occupy space, the latter firm exhibiting electrically-driven machinery, pumps, electric lighting art metal fittings, &c., and at their stand practical demonstrations of the manufacture of Robertson electric lamps are given. The Corporation also occupies a stand, electrical accessories of all kinds being lent for exhibition by several well-known firms in the trade. An electric kitchen has been fitted up, where lunches and teas are prepared by electricity, and served daily at popular prices. A gathering of engineers from neighbouring towns was held yesterday at an electrically-cooked luncheon. We hope that Mr. W. T. Le Feuvre's efforts in arranging this interesting exhibition may meet with success, and result in a good addition to his day-load.

Birkenhead.—The T.C. has fixed the price of energy supplied to consumers in the township of Prenton as follows:—October 1st to March 31st, 8d. per unit for the first hour and a half, 6d. per unit for the second hour and a half, and 2½d. per unit afterwards. April 1st to September 30th, 8d. per unit for the first half-hour, 6d. for the second half-hour, and 2½d. afterwards. Flat rate 7d. per unit.

Bradford.—The Electricity Committee has recommended that, in view of the charges raised against the Committee and the city electrical engineer in the debate at the last Council meeting, and of the fact that, in the opinion of the engineer, serious expenditure not yet estimated will be necessary, an expert, to be nominated by the President of the I.E.E., shall be appointed to report:—(1) On the condition of the plant of the electricity department as it was in 1903; (2) As to the necessity for alterations and additions since sanctioned; (3) Whether the engineer adopted correct means of surmounting difficulties with which he had to contend; and (4) Whether the re-organisation of the department was an improvement.

A spirited discussion arose on the subject of the recent appointments under the Committee, and, according to one local paper, particularly with regard to the appointment of assistants from Poplar.

Bridgnorth. — The Shropshire and Worcestershire Electric Power Co. having declined to insert a clause providing that cables should not be laid, generating stations erected, or energy supplied in bulk or otherwise within the borough without the consent of the T.C., the Corporation has decided to present a petition against the company's Bill.

Carlisle.—The Electricity Committee recently submitted the terms of the Tudor Accumulator Co., Ltd., for the supply of a battery of 266 cells, at the price of £726, payable by three instalments, with the sum of £55 per annum for maintenance for a period of 10 years, payable half-yearly in arrear, subject to an agreement being entered into in respect of such maintenance, determinable at the option of the Corporation by six months' previous notice. The Committee recommended that the terms be accepted, and the T.C. agreed.

Darlington.—Presiding at the annual meeting of the Weardale and Consett Water Co. at Darlington recently, Sir David Bale stated that "the gradual and growing adoption of electric power might lead to some diminution in the demand for water for manufacturing purposes; and the directors thought it more prudent to hold their hands and not to commit themselves to the very large expenditure which the construction of any further reservoirs would entail—though they had got the necessary Parliamentary powers—until they saw in what way some of those doubtful points were going to be solved."

Dartmouth.—It was arranged for Messrs. Edmundsons' travelling exhibition to be opened here on Wednesday last, 22nd inst., and for the proceeds to be handed over to the Dartmouth and Kingswear Cottage Hospital.

Devonport. — The Corporation E.L. Committee has decided to fix 40 arc lamps in St. Aubyn Street, Chapel Street, Catherine Street, Marlborough Street, Newpassage Hill and William Street (Morice Town).

Dorchester.—The Corporation has decided to send representatives to London, to meet those of the Dorchester E.L Co. at the B. of T. offices, in regard to the company's application for a prov. order for the supply of electricity in the borough.

Dublin.—We printed a short note in last week's issue regarding a letter from the L.G.B. to the Corporation respecting the recent application for borrowing powers for extensions at the electricity works. The report of the Board runs as follows:—

"It appears from the evidence taken at the inquiry, and from a statement prepared by you, dated the 13th ult., that a sum of about £325,322 has been expended since 1900, in connection with the general scheme, as, in addition to other loans, the Corporation have expended £6,444 for works within the old city area, stated to be intended for, or fairly chargeable to, the lighting of the Clontarf district, and that including all claims for extras the probable cost of the buildings at the Pigeon House station is £39,674, as against a provision of £21,700 in the original estimate, and the cost of dredging in the harbour, for which no provision was made, is £1,825. It should also be observed that although a proposed loan of £28,000 to provide mains and arc lamps for Clontarf, was inquired into more than a year ago, the Corporation have not yet submitted any definite proposals for the execution of this work."

"The increase from the capital expenditure of about £85 per KW. on the original estimate of £254,500 for an output of 3,000 KW. of total capacity, to an actual cost of about £108 per KW. has a very serious effect upon the financial prospects of the undertaking, which is burdened in addition by about £18 per KW. for the unpaid balances of loans for earlier installations."

"It further appears that the loss which will be shown in the E.L. accounts for the year ending March 31st, 1905, will be at least £10,300, that the arc lighting of certain streets will exceed the former cost of gas lighting by £7,047, and that these sums constitute a charge of nearly 6d. in the £ on the rate in the old city area. This heavy burden on the general body of the ratepayers does not secure proportionate benefit, and it appears necessary to consider the existing conditions very carefully with a view to their improvement."

The Pigeon House works are not at present in as satisfactory a position, as would have been secured if the plans on which the loan of £254,500 was sanctioned, had been adhered to, and this will probably increase the working cost. Another adverse condition is that as the present demand for electricity from the works during the day is very small, a 500-KW. set has to be kept running for a day supply of only about 70 KW. Here it may be mentioned that attention was drawn at the inquiry held in March, 1900, to the risk of such a result if smaller units of generating machinery were not provided.

"A very large outlay has already been made on trunk feeders and distributing mains, but considerable outlying portions of the network of mains are unproductive of revenue, and in the best part of the city—the old area of lighting supply—the mains are insufficient, largely on account of the impossibility of carrying out the engineer's original proposal to increase the capacity of the old mains by about 50 per cent., at a cost of £2,000."

The erection of the proposed new 1,500-KW. generating set, without any addition to the buildings, boilers and trunk feeders, will, it is stated, only provide a further output for sale of 400 KW.

It is expected that by an expenditure of about £47,000, roughly, for boilers, mains, &c., the Committee would be enabled to work the new 1,500-KW. set at an output of 1,100 KW. thus adding 50 per cent. to the present possible maximum output.

"It was estimated by the engineer that if the output of 2,400,000 units for private consumption which would then be possible were sold at 4d. per unit, a gross annual profit of £29,803 would be received, which would cover interest and sinking fund and leave a good margin, but it would appear that this estimated gross profit would not cover the necessary annual payment in respect of loans."

"In view of all the circumstances of the case, it appears to the Board that the Corporation are not yet in possession of clear and comprehensive information as to what is required to convert the Pigeon House scheme into a successful undertaking, and the Board considers that the Corporation should, without delay, investigate most carefully the question as to what additional capital expenditure is necessary to provide for a larger output for private consumption, than has yet been estimated for by their engineer, and to enable them to fulfil their statutory obligation to extend the electric supply to Clontarf. Without very careful management, it will be found impossible for some years, irrespective of the amount of capital expended, to prevent an annual loss in the working of the undertaking or to reduce the present average sale price of 4½d. per unit to the more moderate figures which are charged for electrical supply in other places."

With respect to the application for sanction to the loan of £21,000, the Board states that it sees no reason to question the wisdom of providing the additional 1,500-KW. generating set, and it will be prepared, at the proper time, to sanction a loan for the purpose; but, in the meantime, it trusts that the Corporation will, without delay, apply itself to the serious questions raised at the inquiry, as to how the general scheme can be improved in order to prevent annual loss to the ratepayers, and as to the extension of an electric supply to Clontarf, which is mandatory on the Corporation under their Act of 1900.

East Retford.—The B. of T. has revoked the 1899 electric lighting order.

Exeter.—A private meeting of the City Council was held last week, under the presidency of the Mayor, to inquire into the question as to the competency of the electrical engineer to discharge the several duties devolving upon him. It was understood that no specific charges were brought against the electrical engineer. The chairman of the Finance Committee severely criticised the electric light undertaking from a financial point, and the discussion was chiefly directed to this side of the subject; he said he looked forward with a great deal of anxiety to the possibility of the undertaking not being a success. It was eventually resolved that the general management of the undertaking, and also the question of the competency of the electrical engineer, should be referred to a Special Committee to report on.

Galashiels.—The T.C. has resolved that the E.L. Committee open up negotiations for agreement with a company, under which the latter would carry out the obligations of the Corporation's E.L. prov. order on the basis that the company provide the capital required.

Grantham.—At the electrical exhibition, organised by the Urban Electric Supply Co., and opened by the Mayor on 16th inst., at the Wharf Road Hall, dining and drawing rooms are fitted up to show the artistic effect that can be obtained by electric lighting, and electric radiators take the place of an ordinary fire grate. Various machines may be seen in motion, operated by electricity, heating and cooking apparatus are displayed, and also Röntgen Ray and Finsen apparatus. The company will give the gross proceeds from the exhibition to the Grantham Hospital. The exhibition was to close yesterday.

Grays (Essex).—The E.L. Committee has recommended the U.D.C. to apply for a loan of £6,000 for extensions at the electricity works.

Holyhead.—At a recent U.D.C. meeting, the clerk reported that it had been arranged with the Liverpool Corporation to borrow £13,700 for an electricity works and £3,300 for a destructor.

Hornsey.—The chairman of the Electricity Committee has issued a statement which shows that since the Council obtained the E.L. order, the price of gas in the district has been reduced by 1s. a 1,000 ft. The Council now proposes to reduce the price of electricity.

London.—CHELSEA.—In consequence of the L.G.B. requesting the Baths Committee to re-consider the question of installing an electric plant in the new buildings, negotiations have been re-opened with the Chelsea Electricity Supply Co. The company has offered that, conditional upon the Council agreeing to take for five years, the whole of the supply of electricity which might be required, the company would at once make a reduction to 3½d. per unit on the present supply to the Town Hall and Public Library, and as soon as the company commenced to supply the New Baths, the price for the whole of the supply to the municipal buildings would be fixed at 3d. per unit. The Committee has provisionally accepted this offer.

STOKE NEWINGTON.—A transformer station is to be erected on a site granted to the B.C. by the Metropolitan Water Board in Green Lanes.

The B.C. has come to an agreement with the Islington B.C. whereby the latter authority will supply energy in bulk for premises at the corner of Blackstock and Seven Sisters Road.

METROPOLITAN ASYLUMS.—Messrs. Bergthiel & Young have completed the electric light installation at the Eastern Hospital, at a total cost of £3,445, or £66 in excess of contract price.

HAMMERSMITH.—The electrical engineer has been instructed to prepare a scheme for lighting Netherwood Road by arc lamps.

BERMONDSEY.—The B.C. has approved the estimates in connection with the proposed supply to the Surrey Commercial Dock Co.; and sums of £264 and £204 have been charged to capital account. A sum of £30 has been paid to the holder of a public house as compensation for loss of trade and shock sustained through the explosion in Bermondsey Street.

Richmond. — The T.C. has asked the Richmond Electric Light and Power Co. to give an estimate of the cost of lighting the streets.

The B. of G. has referred to a committee, the question of generating its own energy for E.L. by means of surplus power from the workhouse boilers.

Louth.—The E.L. Committee has recommended the T.C. to request the consulting engineers to submit an alternative estimate for the cost of a suitable E.L. plant driven by producer gas.

Mansfield.—The T.C. on Friday last decided to reduce the price of energy supplied on the maximum demand system, from 7d. and 2d. to 7d. and 1d. per unit for lighting, and from 6d. and 1d. to 4d. and 1d. per unit for power.

Neath.—The B. of T. has revoked the R.D. electric lighting order, 1901, as to so much of the area of supply as is not included in the parishes of Blaenrhondda, Coedfranc, Dyffrn, Clydach, Dylais Lower, and Llantwit Lower.

Rawtenstall.—The T.C. has decided to ask the B. of T. to defer the consideration of the question of revoking the electric lighting order, 1899, for a further period of two years from May 1st, 1905.

South America.—A company has been formed in Chile for carrying out electric light and power installations in the provincial towns throughout the Republic.

The Uruguayan Government has received an offer for the purchase of the electric light undertakings in Monte Video. £200,000 is the price offered on behalf of a local syndicate. If this is accepted, the promoters propose to lay underground mains.—*Review of the River Plate.*

Southport.—The assessment of the electricity undertaking has now been definitely settled. Until recently the assessment was fixed at £700, but the Assessment Committee a year ago raised the sum to £5,500. Negotiations were opened and the latter sum has been reduced to £3,000, which will apply both to the year ending March 31st, 1904, and March 31st, this year. The sum is, we understand, considerably more than the assessment of other towns of a similar size.

Solihull.—The U.D.C. has appointed a committee to ascertain the probable number of consumers of electricity, prior to adopting a scheme.

South Shields.—The Electricity Committee has resolved to recommend to the Corporation, a reduction in the prices for energy to private consumers from 7d. and 2d. per unit, one hour maximum demand, to 7d. and 1½d, and from 5d. to 4d. per unit on the flat rate.

Stafford.—The T.C. has resolved to let out electric motors on the five years' hire-purchase system.

Sudbury.—At a meeting of the U.D.C. on February 14th the revocation of the E.L. order by the B. of T. was considered, and the Mayor (Ald. E. L. Mauldon) stated that he was in communication with Sir Cuthbert Quilter, in the hope that the Board of Trade would receive a deputation on the question of the order being renewed.

Swinton and Pendlebury.—The U.D.C. has applied to the L.G.B. for a loan of £6,900 for electricity purposes.

Wakefield.—The T.C. has decided to apply for a loan of £18,000 for E.L. extensions.

Weybridge.—The U.D.C., on March 15th, sealed a petition against the Weybridge and Walton Electric Supply Co.'s Bill.

Wilmslow.—The U.D.C. has sealed an agreement with the Alderley Electric Supply Co. for the supply of energy for public lighting.

Wishaw.—The Clyde Valley Electric Power Co. expect to supply energy to the burgh next month, and in consequence of this the Council has appointed an electrical engineer for the burgh.

Yarmouth.—The T.C. has applied to the L.G.B. for a loan of £420 for the extension of the E.L. mains to Marine Parade South, which is to be lighted with arc lamps.

Messrs. Preece & Cardew have offered to undertake the oversight of the electric lighting installation extension, at a reduced fee of 3½ per cent. on £10,000.

TRAMWAY AND RAILWAY NOTES.

Adelaide (S.A.).—We have been favoured with a copy of the Adelaide "Tramways Electric Traction Act, 1904," which authorises the Government to purchase various existing horse tramways, which are shown on a map, also received. The period in which an agreement as to price had to be arrived at between the Government and the companies concerned was to expire on February 14th, and last month, in view of the improbability of such an arrangement being made by mutual agreement, steps were taken for the appointment of arbitrators to determine the price to be paid. Pressure upon our space will not permit of reprinting many of the particulars, but we shall be willing to place our copy of the Act on view in this office so that any contracting firms who may be thinking of tendering may inspect same if they wish to do so. The tenderer will purchase all the tramways and undertakings bought by the Government at the same price as is paid by the Government. The work of conversion must commence six months after the date of accepting the tender, and twenty miles must be completed within one year from such date. Every tenderer must deposit security money amounting to £20,000. No employee will be allowed to work more than forty-eight hours per week, except in cases of emergency.

Bath.—An inquiry was held by the Light Railway Commissioners on February 15th, relative to the application of the Bath Electric Tramways Co. for power to construct tramways through Westgate Street, and from Weston to Newton St. Loe. Opposition was offered by the Somerset County Council and by those owning the frontages in Westgate Street. The Commissioners expressed themselves favourably to the extension to Newton St. Loe, but intimated that they could not sanction the Westgate Street line in the absence of the approval of the Corporation.

Birmingham.—The Corporation has resolved, in deference to wishes of the Homœopathic Hospital, not to put trams in Easy Row, and to put a single track in Monument Road between Icknield Port Road and Great Tindal Street instead of double track This, along with one or two other amendments to the new Bill before Parliament, were agreed to on Wednesday.

Glasgow.—At the Westminster Palace Hotel, London, on Monday, Lord Balfour of Burleigh heard parties further in regard to the arbitration between the T.C. Tramway Committee and the Paisley District Tramways Co. regarding the former exercising running powers over a mile of track belonging to the latter company. His Lordship gave his award some time ago, but the parties were not agreed upon the interpretation of it, so far as it concerned the question of the cost of the electrical energy for the running of the cars. Lord Balfour intimated that, while he could not make any addition to the award in fixing the working expenses which he previously allowed the Corporation, he had intended that to those expenses would be added a sum to cover electrical energy.

A proposal is before the Tramways Committee to construct a line down Berryknowes Road, connecting the Paisley and Govan cars.

In connection with the application by nine foremen in the tramways department, who propose, on the spring holiday, visiting one of the most modern car machinery works, to have their travelling expenses paid by the department, the Committee have recommended that £25 be given.

The general manager has been asked to report on the lifeguards for cars in use in Dundee.

On the suggestion of the general manager, it has been decided to advertise for offers for two motor-cars, for the use of the engineers and for offers for three additional motor-tower wagons to replace horse wagons.

Manchester.—In the course of an address which he delivered a few days ago to an association in Manchester, Mr. Boyle, the Chairman of the Tramways Committee, mentioned some interesting facts. The City of Glasgow, he said, led the way in the municipalisation of tramways in 1894. Its example had since been followed by 162 different municipalities in the United Kingdom. From 1877 to 1901 a private company (The Manchester Carriage and Tramways Co.) ran the trams in Manchester on lines leased from the Corporation, using only horse traction. In about two and a half years the Corporation had reconstructed and electrically equipped the whole system, extending to 110 miles, and that without much inconvenience to the public or interruption in the running of the cars. Another car-shed is to be erected in Withington Road on the site of the Carriage Company's old depôt. Mr. Boyle described in some detail the precautions taken to ensure the safety of the public and the conditions of work of drivers and conductors. As to the financial aspects of the undertaking under municipal control, these, he remarked, were highly satisfactory. The Committee paid into the City Fund, at the end of the first full year's working, a sum of £50,000, and for the current year this satisfactory payment in relief of rates would be increased by about £5,000. Personally he approved of the policy of the Glasgow Corporation, and would gladly see more money laid aside to pay off capital and interest, in order to provide against the possibility of the present plant becoming obsolete. Whilst he thought the tramway system had nothing to fear from the threatened opposition of motor omnibuses, it was only prudent to keep in view the possibility that something might be discovered which would depreciate Manchester's splendid electrical plant. The parcels carrying department in connection with the municipal tramways is to be opened in April. It has also been suggested that the lines should be used for conveying heavy goods from the Ship Canal Docks to neighbouring towns, such as Stockport and Oldham. This, however, is a matter for future consideration. An experiment with motor omnibuses is to be made on Palatine Road, between the tramway terminus at Withington and the Village of Northenden. On this section (about two miles) the Corporation at present runs horse omnibuses only, as feeders to the tram lines. The intention is ultimately to extend the tramway from Palatine Road to Northenden, and thence to Gatley, the terminus of the Stockport system, and to Sale in the Altrincham direction.

North London Railway.—Lord Rathmore told the shareholders last week that electrification, as a means of meeting the Great Northern and City Railway competition, was receiving the consideration of the board, but at present the directors did not think it practicable, owing to the amount of goods traffic on the North-London line, and the fact that many of their trains ran over the North-Western and Great Northern systems.

Ormskirk Light Railway.—It has been decided that application shall be made to the Board of Trade by the Ormskirk and Southport Light Railways Co. for an extension to March, 1907, for the completion of the light railway between Ormskirk and Southport.

South Shields.—At a meeting of the Tramways Committee on 14th inst., Alderman R. Redhead asked the members of the Committee to give their serious consideration to the desirability of adopting motor-omnibuses before committing themselves to the more expensive system of electric trams. He emphasised the great strides that the omnibuses were making and their suitability for towns like South Shields, and drew particular attention to the great saving on the capital cost. He moved that before the Committee go into the question of tenders for the proposed system, a committee be appointed to go into the motor-'bus system and report. Councillor Reay seconded the motion. Counciller Henderson opposed the suggestion, holding that in proportion to their carrying capacity the 'buses cost more. The matter was ultimately adjourned for future consideration.

Stirling.—The T.C. has decided not to run electric cars of its own. For some time it has been considering proposals to acquire the existing tramway between Stirling and Bridge of Allan and adopt electric traction. At a meeting of the Council on Monday a resolution was come to that in view of the large sum likely to be required to purchase the undertaking of the present tramway company, the statutory conditions and restrictions that are imposed upon corporations owning and working tramways, and the present state of the money market, and considering also that a large portion of the proposed tramway under any of the schemes considered would be beyond the burgh boundary, and so outwith the burgh's jurisdiction and rating area, it did not feel the time was opportune for putting upon the ratepayers of Stirling the large responsibility which such an undertaking would involve. The Council agreed to give every facility to any private company that might take up the work.

Sunderland.—At the meeting of the Tramways Committee on the 20th inst., the following statement was laid before the members:—

Income.—Actual income, 1904, £63,067; estimated income, 1905, £65,002; estimate for 1906, £65,500.

Expenditure.—Actual expenditure, 1904, £36,318; estimated expenditure, 1905, £40,482; estimate for 1906, £38,910. After allowance for interest, depreciation and renewals fund, the net profit figures are:—For 1904, £4,014; 1905, —; 1906, estimated £2,090. Although no figures are given, it is admitted that much of the increase of expenditure is due to loss on the East End route, the balance being made up of various items of increase.

Urmston.—A committee of Manchester T.C. has recommended that an agreement should be entered into with Urmston U.D.C. for the leasing of the tramway Order for 42 years.

TELEGRAPH AND TELEPHONE NOTES.

Anglo-French Telephones.—By an arrangement made by the English and French postal authorities, telephonic facilities between England and France are to be considerably extended.

Australian Telegraphs and Telephones.—It is proposed by the Central Administration in Melbourne of the Commonwealth telegraph system to utilise the telegraph lines between distant cities for telephone purposes, applications (according to the *Australian Mining Standard*) having already been received for telephone services between Melbourne and Warrnambool, Ballarat and Hamilton, and Frankston and Somerville. It is also proposed to establish direct communication between Ballarat and Geelong.

Canadian Telephones.—The New York *Electrical World* says that the Bell Telephone Co. is contemplating an extensive invasion of Western Canada, during the coming summer. In addition to the company's present plant, it will erect from 10 to 15 general stations, and from 20 to 25 sub-stations. The plant will be so distributed as to give good telephone connection all over Manitoba and the more settled sections of the Canadian North-West Territories. Connection will also be made with the American north-western telephone lines, at various points on the international boundary, so as to give a good service with Minneapolis and other places on the American lines. Mr. L. P. McFarlane, general superintendent of the Bell Co., says that the great growth of business has necessitated this extension, which will involve a large expenditure of money. He states that the Bell policy is to follow the rapid development of the Canadian West with as complete a long-distance service as circumstances will permit.

Exports of Telegraph Cables.—The export trade of this country in telegraph cables and apparatus connected therewith continues exceedingly quiet. The shipments during the first month of the year only attained a value of £58,884, which contrasts with £177,150 in January, 1904, and £91,077 in the first month of 1903.

Field Telegraphs.—Capt. E. Molineux, D.S.O., Indian Army, has invented an apparatus for laying field telephone and telegraph wires at a rapid rate from horseback.

New Atlantic Cable.—The *Daily Telegraph* correspondent at New York announces that the Commercial Cable Co. are about to lay a new Atlantic cable at a cost of £450,000, and the work is to be undertaken by the Silvertown Co. or the Telegraph Construction Co., or by both conjointly. Some objection is being evinced to the contract being awarded to British firms by many people who think the cable should be manufactured in America.

Portsmouth Telephones.—At the last meeting of the T.C., the corporate seal was affixed to a supplemental licence from the Postmaster-General for the extension of the municipal telephone area, so as to include Wickham, Hambledon, Southwick, Lock's Heath and Horndean.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1)	Aug. 26, 1901	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902	
Tarifa-Tangier	Jan. 18, 1904	
Closed { Vladivostok-Nagasaki	Feb. 9, 1904	
Closed { Port Arthur-Chifu	Mar. 9, 1304	
Paramaribo-Cayenne	July 13, 1904	
Jamaica-Colon	Jan. 5, 1905	
Marmaritza-Rhodes	Jan. 30, 1905	
Martinique-Paramaribo	Feb. 14, 1905	
Gibraltar-Tangier	Feb. 20, 1905	
Landlines.		
Puerto-Barrios	July 28, 1902	
Kertch-Soutchoum	Sept. 27, 1904	
Rome-Pera	Jan. 27, 1905	
Bhamo route beyond Tali	Jan. 15, 1905	
Newfoundland—all places in the interior	Feb. 10, 1905	
Fao route beyond Bassora	Feb. 13, 1905	
Pekin-Kiachta	Feb. 18, 1905	Feb. 20, 1905

Telephony in Italy.—Work is in hand on the establishment of a long-distance telephone line between Naples, Rome and Turin.

The Pacific Cable.—Replying to a question put in the House of Commons last week, the Chancellor of the Exchequer said that the amount borrowed for capital expenditure on the Pacific Cable was being repaid by a terminable annuity provided in the Vote for Telegraph Subsidies and Pacific Cable (Civil Service Estimates, Class V., 5). The Colonial shares of the expenditure are recovered from the Colonial Governments after the close of each financial year. The first instalment of the annuity for the repayment of the borrowed capital was included in the Vote for 1903-4, and the Colonial share has been received in the present financial year.

Wireless Telegraphy.—In the House of Commons last Friday, Major Seely asked the President of the Board of Trade whether the installation of wireless telegraphy for life-saving purposes on the East Goodwin, South Goodwin, Gull, Tonge, Sunk, and Cross-sand lightships, as to which arrangements were in progress in June, 1903, had yet been completed; and, if not, at what date the work was likely to be finished. Mr. G. Balfour, in reply, said that the necessary legal agreement between the Board of Trade, Trinity House, and Marconi's Wireless Telegraph Co., with the assent of the Admiralty and the Post Office, had not yet been completed. The legal and administrative difficulties had been great, as it was necessary to deal with questions affecting wireless telegraphy in this country by legislation and to safeguard the rights of the Post Office. He hoped, however, that the completion of the agreement would not be long delayed.

CONTRACTS OPEN AND CLOSED.

OPEN.

Army Contracts.—The Secretary, War Office, is advertising for names of manufacturers who wish to tender for army requirements. See "Official Notices" February 3rd.

Austria.—The municipal authorities of Vienna are about to invite tenders for the supply of 10 electric motor tramcars and 100 trailer tramcars.

Battersea.—February 27th. Coal and other stores for the electricity department. See "Official Notices" February 10th.

Belgium.—March 1st. The Belgian State Railway authorities, at La Bourse, Brussels, are inviting tenders, until March 1st, for the supply of the plant required for the electric lighting of the railway stations at Chenée, Aguesses and Angleur.

Croydon.—February 28th. Coal for one year for the Electricity Works. See "Official Notices" to-day.

Edinburgh.—March 13th. Carbons, meters, boxes, troughing and bitumen for the Electricity Supply Department. See "Official Notices" to-day.

G. W. Railway.—March 13th. Plant (three-phase and direct current) for the proposed sub-stations and distributing centres in connection with the Park Royal generating station. See "Official Notices" February 10th.

Glasgow.—February 27th. The Corporation invites tenders for an electric light installation, &c., required in the new Central Police Office. Specifications and forms of tender at the Office of Public Works, City Chambers, 64 Cochrane Street.

(*Continued on page* 317.)

AN ELECTRICAL REVIEW OF THE LOUISIANA PURCHASE EXPOSITION OF 1904.

By R. BORLASE MATTHEWS, Wh.Ex., A.M.I.C.E.

This Exposition closed its gates to the public, after what appeared to have been a financially and generally successful season. It was the largest, and probably the last of the attempts to bring together, at one place and time, representative examples of the world's varied industries. Commercial operations are being carried out on too great a scale, with too many variations, in these modern times to permit of anything like a fair representation of every class, and thus allow of the relative importance of competing industries being judged.

The tendency in future will probably be to devote such exhibitions entirely to some special industry, instead of making the hopeless attempt of trying to include everything in one monster show. The president of the St. Louis Exposition, Mr. D. R. Francis, in his address of welcome to the members of the Electrical Congress, upheld this view, and stated that, in his opinion, one of the early exhibitions would be devoted to electricity.

It is extremely difficult to judge of the value of such an exhibition from the exhibitor's point of view, as the results are often so indirect and apparently disappointing. It is certainly very valuable from the point of view, that a certain number of visitors come there on business, and not merely for pleasure, and in inspecting the particular things they have come to see, their attention is often drawn to other devices, which otherwise they might not have come across. It also forms a central meeting place for engineers and capitalists, enabling manufacturers to get in touch with them, and better explain the merits of their particular apparatus.

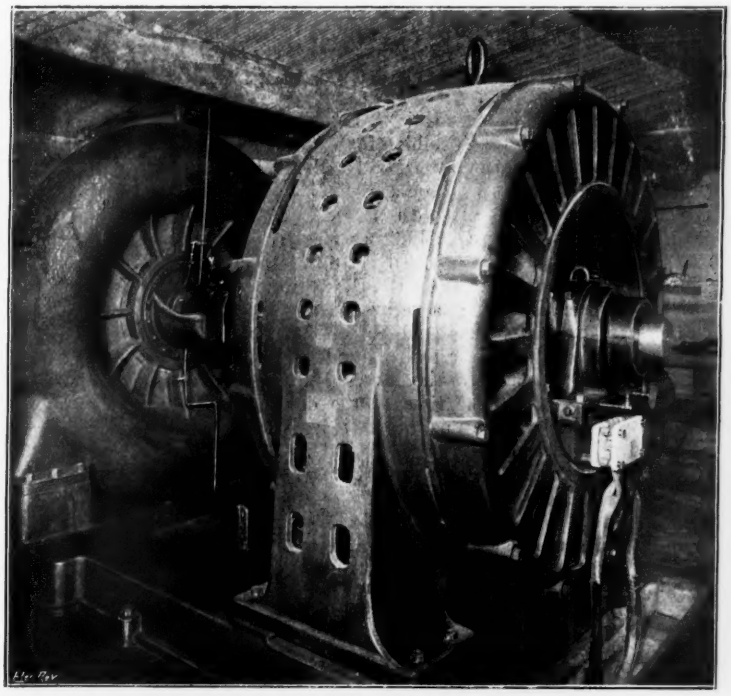


Fig. 1.—Westinghouse 2,000-h.p. Three-Phase Induction Motor Driving Worthington Centrifugal Pump, 11½ ft. High.

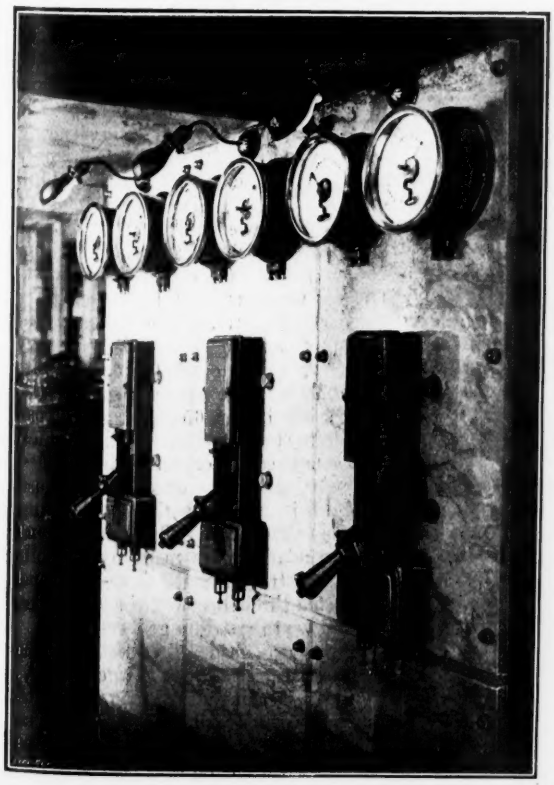


Fig. 2.—Switchgear Controlling Three 2,000-h.p. Induction Motors.

As indicating the state of the arts, the exhibition may have been, and undoubtedly was, a success in many departments, but this certainly could not be said to be the case with the electrical industry. As an exhibition of American progress in this direction, it was probably very good, but as regards that of the world at large, it could not be considered representative. This was, of course, chiefly due to the great

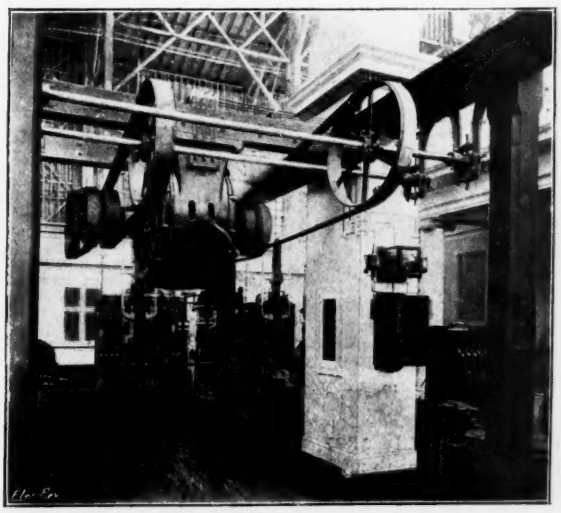


Fig. 3.—General Electric Three-Phase Induction Motor for Cotton Mill Driving.

distance, and also to the high tariffs imposed by the United States on imported electrical machinery.

There were no great electrical developments shown that were not to be seen at the recent exhibitions at Buffalo and Paris, though the details were greatly improved. It seemed almost as if the trust spirit were beginning to prevail and hold back electrical development to a certain extent, by the manufacturers purchasing inventions that were likely to interfere with their existing standards, and then simply letting them stagnate, in this way avoiding competition and maintaining good prices on their existing specialities.

The influence of Mr. T. A. Edison on the American electrical industry is very marked, and still maintains a very important hold. The Association of Edison Illuminating Companies, representing the companies who are licensees under the Edison patents, which include the majority of the lighting companies in the United States, had brought together a very interesting exhibit of apparatus and photographs connected with the inventions of Mr. Edison, much of which possessed great value on account of its history.

Amongst the exhibits of special interest were :—the first commercial steamship electric lighting plant ; the electric locomotive and trailer first operated in 1880 ; the apparatus used in conjunction with the earliest three-wire installation, which took place in 1883 ; a series of early experimental incandescent electric lamps mounted on mahogany bases ; an electrolier, the first ever made, fitted with the original lamps, which were placed in the inverted position which is now so familiar, but at the time of the design, in 1880, was novel ; the positive and negative leads were covered with red and blue coverings respectively. An old type chemical meter was also shown. It is interesting to recall that the first Edison central station for incandescent electric lighting established in the world was that erected at 57, Holborn Viaduct, London, in 1881, which commenced operations in 1882. In 1887, 121 Edison central stations were supplying current to 330,180 lamps.

The incandescent lamp is still made under licence from the patentee, with the result that the prices are higher than in England. A St. Louis incandescent lamp company had an operative exhibit, in which each stage of the manufacture was explained to the visitor by aid of the phonograph. Several of the methods and labour-saving devices used were a great improvement on those adopted in European factories of a similar nature.

Very few polyphase motors were shown, since the Tesla

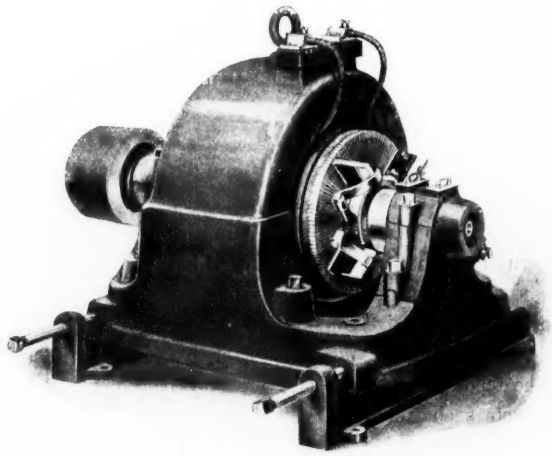


Fig 4.—Wagner Single-Phase Alternating Current Repulsion Motor.

master patents, which completely cover such apparatus in America, are held by two firms alone, and do not expire until next year. There were evidences, however, that a number of other firms were preparing to put this class of machine on the market on the expiration of the patents, and then the polyphase motor in the United States will probably soon attain the prominence it already has in Europe.

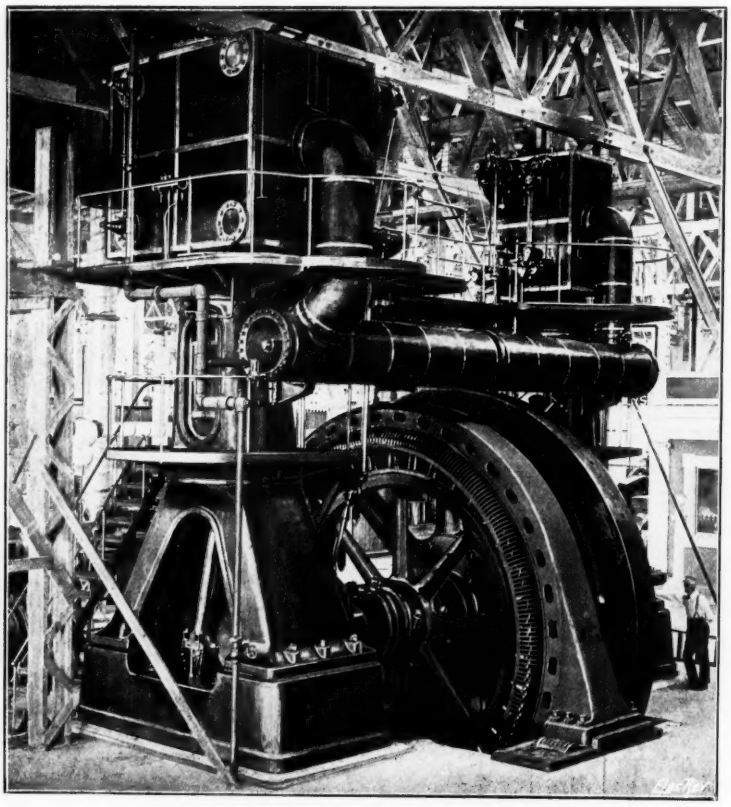


Fig. 5.—National Electric Co. 1,500-kw. Generator.

The Cascades, which were a very attractive feature of the exhibition, were operated by a plant consisting of three Worthington centrifugal pumps, 11½ ft. high, with 40-in. suction and 36-in. discharge pipes. These pumps were direct connected to 25-cycle three-phase Westinghouse induction motors of 2,000-h.p. capacity, which are said to be the largest of their kind yet built. Fig. 1 is a view of one of these motors. The total capacity of the plant was 5,400,000 gallons per hour.

The motors were remarkable not only for their size, but also for their high efficiency and for the high voltage at which they were operated. Power was supplied from the Machinery Building. Neither step-up nor step-down transformers were employed, the power being transmitted direct. The primaries of these motors, which formed the stationary elements, were wound for 6,000 volts three-phase, 25 cycles per second, the rotor speed being 365 r.p.m. The core was slotted to receive the winding, which was composed of copper strap threaded through partially closed slots, and retained in place by the overhanging tips of the teeth. The windings of the secondaries were made up of coils of copper strap arranged three-phase and connected through collector rings of the spider type to cast-iron grid resistances.

Great care had to be exercised in starting up motors of such large capacity, so that the generating plant might not be affected. The pumps were kept filled with water when at rest, and connections were made to the city water mains, in order that they might be refilled should they chance to lose their water. At starting, the voltage at the generators was reduced to about 4,500, being gradually raised to 6,600. The large oil-immersed controllers were divided into 54 steps,

and were operated by hand. The starting was done throughout the Exposition without accidents, taking place very smoothly, the starting current being raised very gradually from about one-half to the normal current. Since the motors were situated in a very humid place, they were protected against the effects of moisture by circulating a continuous current through the windings when they were at rest. The switchboard was provided with high tension oil-immersed automatic circuit-breakers, and with ammeters and voltmeters. An illustration of the switchboard and controlling apparatus is given in fig. 2.

Fig. 3 is a view showing the General Electric Co.'s three-phase induction motor, specially designed for use in cotton mills. The three-phase motor, on account of its property of constant speed, has been very successful in cotton mills, since the machinery used there is very sensitive to variations of speed. The continuous current motor has not been found so suitable on account of its alterations in speed when warmed up, and for other reasons.

Single-phase motors, not coming under the Tesla patents, are manufactured by a number of firms. Various methods of making the motor self-starting are employed. The General Electric Co. arrange the winding of the rotor so that it is left short-circuited, with an auxiliary winding placed upon the stator, which is connected to the line by means of a phase-splitting device, consisting of a specially-constructed condenser. This condenser serves the purpose not only of providing the requisite phase difference for self-starting, but also of compensating for the wattless current when the machine is running. The condenser consists of tinfoil and paraffined paper, and is placed in the base of the motor. A condenser is, however, rather an expensive and objectionable piece of apparatus for practical use, even under the best conditions.

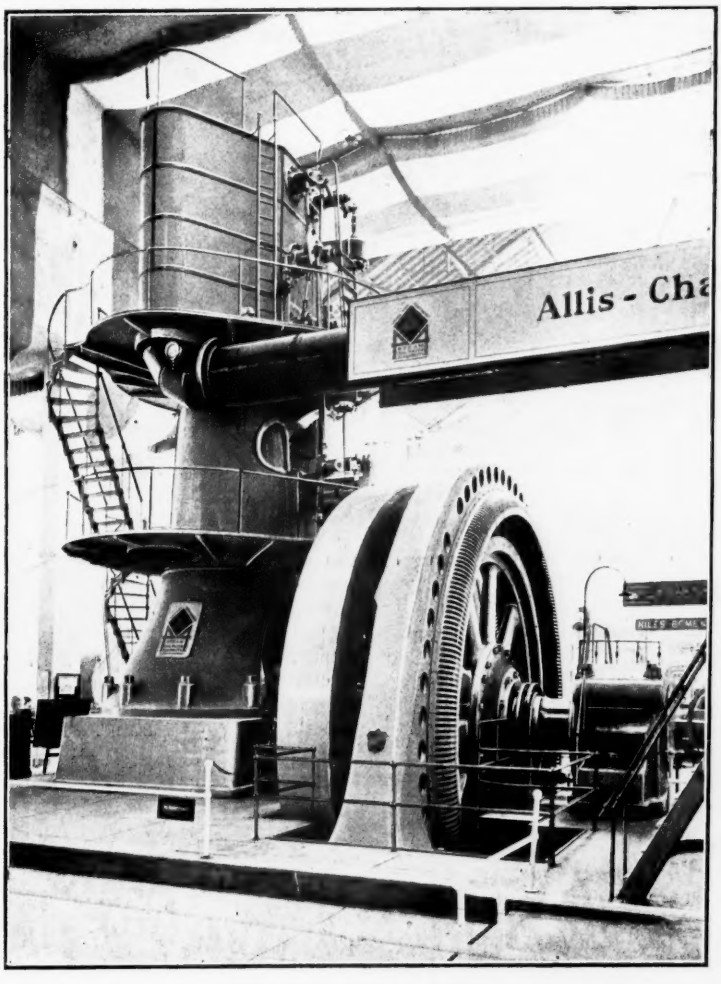


Fig 6.—Allis-Chalmers—Bullock 3,500-kw. Generator.

The Westinghouse Co. employ a short-circuited secondary winding without a commutator or other device, and introduce an auxiliary winding on the primary, depending on a displaced phase relation between the currents in the two windings, caused by the introduction of a non-inductive resistance in the auxiliary circuit for starting. The repulsion principle is adopted by a number of makers, the most important concern being the Wagner Electric Manufacturing Co., of St. Louis, who make a speciality of single-phase motors, turning them out in very large quantities, for use not only on single-phase distribution systems, but also on three-phase, where one phase is used for the motor connections. This type of motor starts as a repulsion or series machine, having a coil-wound secondary provided with a commutator; upon reaching full speed, an automatic centrifugal device comes into play, short-circuiting the commutator segments, and at the same time lifting off the carbon brushes, the machine then running as an induction motor. The mechanical details seem to be well worked out, and the machine appears very efficient. Fig. 4 shows the general appearance of this machine.

A very interesting feature is the development of the alternating current single-phase commutator type of railway motor as carried out by the General Electric Co. and the Westinghouse Co. The former company aim at a controlling system which will permit of the car upon which it is mounted being operated by alternating or continuous current, while the latter, though prepared to supply apparatus suitable for either system, prefer to install controlling apparatus designed for the alternating current system alone.

From the general extent, comprehensiveness and distribution of the exhibits of the two above-mentioned firms, the average visitor is led to believe that there are no other firms of any account in the electrical industry. These firms are so large and their undertakings extend over so wide a field that they seem almost like small trusts, and, like the trusts, apparently adopt the policy of buying out their more serious competitors. The existing companies of smaller capitalisation, however, hold an important position in the electrical industry, and are making their influence felt.

This condition of affairs prevented the display of a number of different types of alternators, such as were shown at the Paris Exposition.

The power service plant of the Exposition, which was described in our issues of Aug. 12th, 1904, and Feb. 3rd, 1905, comprised two Westinghouse and two General Electric generators of 2,000 kw. capacity, the two General Electric machines being in the centre. These sets ran at 83·5 r.p.m., and the current was generated at 6,600 volts pressure and 25 cycles frequency. Fig. 5 shows a 1,500-kw. generator, built by the National Electric Co., of Milwaukee, which supplied part of the power required for operating the large pumps, the immense streams from which flowed over the ornamental cascades in front of the Festival Hall, on the main plaza of the Exposition. Incidentally, this photograph also shows the unsightly type of roof construction adopted, which in many cases interfered with the larger exhibits, preventing an unobstructed view.

The r.p.m. of this set were 83, periodicity 25, and voltage 6,600. The general design of the machine was such that, owing to the good ventilation, the temperature rise did not exceed 30° on the armature and magnets in a continuous run at full load, and 40° in a continuous run at 25 per cent. overload. The field poles were circular in section, which allowed of more efficient cooling than was the case with other shapes; this shape of pole meant a machine of larger

diameter, which would also be more expensive were it not for the fact that the designer had not to keep the temperature rise so much in view, and so could adopt a cheaper general design. A distributed form of winding was used, with open slots, which gave a low inductance, and therefore, as the load increased, only a small increase of exciting current was required. The reacting effects of lagging current were also minimised, thus improving the regulation on loads of low power factor.

"The Big Reliable" was the name given to the 5,000-H.P. Allis-Chalmers engine and Bullock generator (fig. 6), which was used to supply the power for the decorative lighting of the Exposition buildings and grounds. The engine was remarkable as being the largest single engine yet built for alternator driving; engines of this size are usually of the twin type, erected one on each side of the generator. The capacity of the generator was 3,500 KW., voltage 6,600, cycles 25, 83·5 r.p.m.

The speed of this set was regulated from the switchboard by putting in operation a small motor mounted on a lever attached to the governor balance weight, which acted as an additional weight—by its rotation, sliding itself along the lever to the required position.

It will be noted that all these alternators were of the revolving field type, as this is the usual American practice for general all-round work, best meeting the requirements of suitability for large currents, very high voltages and varying power factors. Good regulation is another feature insisted on, which must be carried out without the aid of any auxiliary automatic devices. Also the wave form must approach a sine curve. All of these features are more easily obtained from a machine of the revolving field type. The general appearance and design of all these machines do not differ very greatly from each other, and so they do not offer such an interesting comparison as was afforded at the Paris Exposition. They are, however, an indication of the large size of modern electricity generators and prime movers. Large as these are, they appeared small alongside the full size model, built in plaster, of the armature of the 5,000 KW. Westinghouse generators built for the elevated and subway train service in New York City, which was used as an entrance arch to the main service generating plant. This armature stands 35 ft. high.

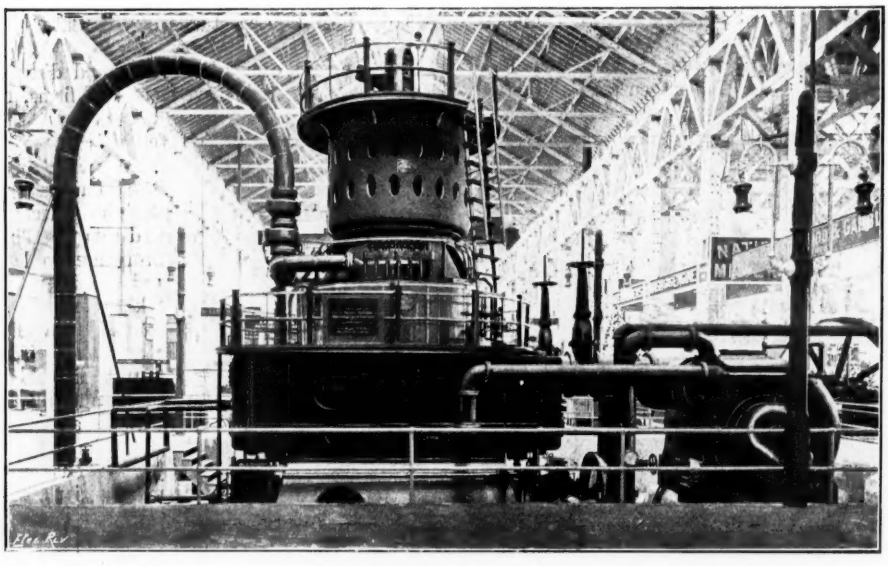


FIG 7.—CURTIS 2,000-KW. TURBO-ALTERNATOR, WITH CONDENSER BENEATH.

A feature which received special attention was the turbo-alternator. Of these, machines were exhibited of the Westinghouse-Parsons, the Curtis, the Holzwarth-Bullock and the De Laval types.

The Westinghouse Co. had one of their smallest turbine units in operation, namely, a 400-KW. machine. They claimed that this set had been kept turning throughout the whole time the exhibition was open, without a hitch. A similar machine was shown open for inspection, so that the construction might easily be seen; this was a good idea, and attracted a good deal of attention. The generator was wound for three-phase, 60-cycle current at 440 volts.

The Curtis turbine, having a capacity of 2,000 KW. at 750 r.p.m., and wound for three-phase, 25-cycle current at 6,600 volts, was of the latest type, fig. 7, having the surface condenser mounted directly underneath and as a part of the machine itself, thus greatly economising the space required by the auxiliary apparatus. The speed was kept constant by aid of electrically-controlled admission ports of the latest type.

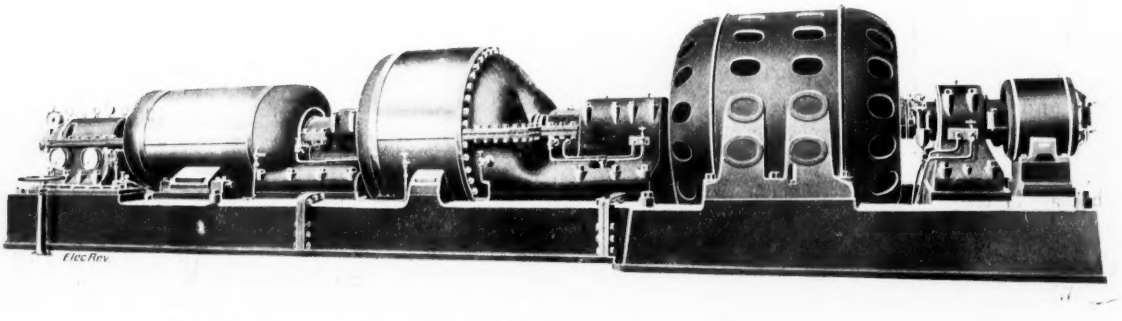


FIG. 8.—HAMILTON-HOLZWARTH STEAM TURBINE AND BULLOCK 1,000-KW. ALTERNATOR.

The Hamilton-Holzwarth turbine (fig. 8) was of the Rateau type, of 1,500 H.P., direct connected to a Bullock 1,000-KW. alternator, running at 1,500 r.p.m. The turbine casing was divided into two parts, one for the high-pressure and the other for the low pressure steam. In the event of an overload, steam could be admitted direct through a nozzle into the low-pressure casing.

A number of turbines of the De Laval type were in operation in the Mining Gulch, and one was also shown

in connection with the Bullock Co.'s exhibit. These were all of small size, as is necessitated by the exceptionally high speed at which they run. One of the wheels was shown apart from the casing, and it was noteworthy how small it was when compared with the output obtained by its use as a rotor. The nicely-finished spiral reduction gears were a good example of modern machine work.

It was very interesting thus to have the principal turbines of the present time collected together in this way, affording a good opportunity for comparison. The Curtis turbine seemed to present the best appearance, possibly on account of its height and length being more in proportion than was the case with the Westinghouse and Holzwarth types.

(*To be continued.*)

CONTRACTS OPEN AND CLOSED.

OPEN.

(*Continued from page* 312.)

Gloucester.—March 16th. Boilers, 600-KW. generator, condensing plant, piping, feed pump, &c., for electricity supply extensions. See "Official Notices" to-day.

Hull.—March 1st. Mains and cables for one year. See "Official Notices" February 17th.

Ilford.—February 27th. Coal, meters, cables, lamps, &c., for one year. See "Official Notices" February 17th.

Johannesburg.—March 6th. 100 electric cars, two electric water cars, five-ton crane, car traverser, and workshop tools, for the Municipal Council. See "Official Notices" December 30th.

King's Lynn.—February 28th. One 200-KW. steam dynamo, condenser, pipes, &c. See "Official Notices" February 17th.

Leeds.—March 14th. Rotary converters, transformers, and switchboards for two sub-stations. See "Official Notices" to-day.

Lowestoft.—March 9th. One water-tube boiler with superheater, brickwork and accessories, and pipework. See "Official Notices" February 17th.

Manchester.—March 6th. Stores, &c., for the Tramways Department. See "Official Notices" to-day.

Newport (Mon).—March 6th. 300-KW. continuous current tramway generator; 200-KW. continuous current steam balancer; one (straight tube) water-tube boiler and superheater; marble switchboard; extension of switchboard gallery; general stores including lamps, carbons, engine room stores and electrical stores &c. See "Official Notices" February 17th.

Porto (Portugal).—March 15th. The Town Council has opened a competition for the concession for the exclusive right of working the tramways for the collective transport of passengers, luggage, and goods in all the municipal public ways. The conditions of the competition are published at the Portuguese Consulate in London.

Salford.—March 4th. Alterations to batteries. See "Official Notices" February 17th.

Shanghai.—March 31st. Construction and working of 24 miles of electric tramways on the trolley system, double or single. See "Official Notices" October 14th.

Spain.—March 1st. The Spanish Post and Telegraph Authorities in Madrid are inviting tenders until March 1st for the concession for the establishment and working of a telephone exchange in Albacete. Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Correos y Telegrafos, Carretas, 10, Madrid.

Spain.—March 1st. The Spanish Post and Telegraph Authorities in Madrid are inviting tenders until March 1st for the concession to establish and work an interurban telephone line between Barcelona and Martorell. Particulars may be obtained from La Direccion General de Correos y Telegrafos, Carretas, 10, Madrid.

South Shields.—March 13th. Boiler, two vertical engines and 550-KW. traction generators, and traction switchboard for the Corporation. See "Official Notices" February 10th.

Willesden.—February 28th. Maintenance of telephones for the D.C. See "Official Notices" February 17th.

Wimbledon.—March 4th. Stores for the electricity department. See "Official Notices" February 10th.

Wrexham.—March 10th. Supplies for the Electricity Department. See "Official Notices" to-day.

Yarmouth.—March 1st. Two water-tube boilers, and a 300-KW. steam alternator. See "Official Notices" February 17th.

CLOSED.

Battersea.—The B.C. has placed an order with Messrs. Babcock & Wilcox, Ltd., for three water-tube boilers at the generating station, similar to those already erected there and fitted with chain grate stokers, for £3,600.

Bournemouth.—The T.C. has decided to accept the tender of Messrs. J. G. White & Co. to lay the tramway line between Pokesdown and Christchurch, at £38,964.

Dartford.—The U.D.C. has renewed the contract with Messrs. S. W. Gibson & Co. for free wiring for a further period of six months.

Glasgow.—The Sub-Committee on Stores of the Corporation Tramways has recommended for acceptance the following offers:—

The Lorain Steel Co., special track work.
Messrs. Estler Bros., trolley bases.
Messrs. Brecknell, Munro & Rodgers, trolley poles.
J. Patter & Co., Ltd., teak fitches.
Hadfield's Steel Foundry Co., Ltd., emery grinder.
A. Braud & Co., Ltd., canvas.
Callender's Cable & Construction Co., Ltd., telephones, cable.

Hammersmith.—The B.C. has received the following tenders for cables:—

Western Electric Co. (accepted)	£1,057 3 0
Callender's Cable & Construction Co., Ltd.	1,155 10 0
W. T. Henley's Telegraph Works Co., Ltd.	1,168 10 0
British Insulated & Helsby Cables, Ltd.	1,195 10 0
Electrical Co., Ltd.	1,196 14 4
Siemens Bros. & Co., Ltd.	1,222 10 0
St. Helen's Cable Co., Ltd.	1,297 19 5
W. T. Glover & Co., Ltd.	1,312 2 6

Lancaster.—It was decided at the meeting of the Corporation on February 22nd to purchase two additional cars from the British Westinghouse Co., at £570 per car; and to accept the tender of Mr. W. Constable, of Bradford, for advertisements in the cars at £26 per running car. A sub-committee is recommending the use of motor-omnibuses for districts not yet supplied with the electric cars.

Rothesay.—The contract for the excavations, track and permanent way work in connection with the extension of the car system to Ettrick Bay has been let to Messrs. Dick, Kerr & Co., Ltd., for £15,767.

Poplar.—The Electricity Committee received the following tenders for the installation of an additional boiler, &c.:—

No. 1 Scheme.

Babcock & Wilcox	£2,402
Stirling Boiler Co.	2,161

No. 2 Scheme.

Babcock & Wilcox	£2,112
Stirling Boiler Co. (accepted)	1,950

For the installation of a pump capable of discharging 10,000 gallons per hour:—

G. & J. Weir, Ltd. (tandem compound) (accepted)	£245
Evans & Co. (beam compound)	255
Clarke, Chapman (tandem compound)	250
Pulsometer Engineering Co. (compound)	145

Sheerness.—Messrs. Johnson & Phillips have secured the contract from the Admiralty for two direct-current dynamos for the Sheerness Dockyard.

Yarmouth.—The T.C. has accepted the following tenders in connection with the Gorleston Tramways:—

Brush Electrical Engineering Co., Ltd., cars, £5,646.
British Electric Equipment Co., overhead equipment, £2,357.
Messrs. Dennis & Co., rail-bonds, £480.
Messrs. T. Small & Co., 500 tons granite setts, £1 0s. 6d. per ton.

Explosion on a Submarine.—The recent accident to Submarine A 5, while lying in Cork Harbour, was the subject of a coroner's inquiry on Saturday last. From the expert evidence given, it was surmised that the explosion of petrol vapour was caused by an electric spark, although where the latter occurred was undecided. It appeared probable that the presence of petrol vapour was unsuspected by the crew when they operated the electrical apparatus.

Institution of Mechanical Engineers.—In the report submitted at the annual meeting held at Storey's Gate last week, it was announced that the total number on the roll of the Institution at the end of last year was 4,477, which showed a net gain of 266. During 1904 no fewer than 460 candidates were elected. Having regard to the higher standard of qualifications now required, the members were congratulated on this increase in the numbers. It was stated that the first report by Prof. David S. Capper to the Steam Engine Research Committee had been completed, and that the Alloys Research Committee, under the chairmanship of Sir William H. White, had continued its work at the National Physical Laboratory. It was announced that Mr. Edward P. Martin (Dowlais) had been elected President for the ensuing year.

FORTHCOMING EVENTS.

To-day's Arrangements.—At 5 p.m. Physical Society. Meeting at the Royal College of Science.
At 7.30 p.m. I.E.E. (Manchester Students). Mr. Buttenshaw on "Metallography."
At 7.30 p.m. N.E. Coast Institution of Engineers and Shipbuilders. "Application of Electricity to Industrial Purposes," by Mr. J. F. C. Snell.
At 8 p.m. Electro-Harmonic Society. Concert (Ladies' night) at King's Hall, Holborn Restaurant.

Saturday, February 25th.—Association of Engineers-in-Charge. Dance.
At 2.30 p.m. I.E.E. (Students). Visit to the Great Northern and City Railway. (Meet at Moorgate Station.)
At 3 p.m. Visit to the G.P.O. Central Telephone Exchange.
Monday, February 27th.—At 8 p.m. Society of Arts. "Internal Combustion Engines," by Mr. Dugald Clerk. (Lecture III.)
Tuesday, February 28th.—At 7.30 p.m. I.E.E. (Manchester). "Mechanical Construction of Steam Turbines," by Mr. W. J. A. London.
Wednesday, March 1st.—At 7.30. I.E.E. (Students). Discussion on "The Gas Engine *v.* The Electric Motor for Small Workshop Driving."
At 8 p.m. Institution Civil Engineers. Discussion on "Surface-Condensing Plants, and the Value of the Vacuum Produced," by Richard William Allen.
Thursday, March 2nd.—At 8 p.m. Civil and Mechanical Engineers' Society "Engineering Expert Evidence," by Mr. J. F. Reade.
At 8 p.m. I.E.E. Extraordinary meeting. "Type-setting by Telegraph," by Mr. Donald Murray. (Discussion.)
At 8 p.m. Chemical Society. Meeting.
At 8.15 p.m. Röntgen Society. Discussion on "The Necessity of Accurate Measurement in X Ray and High Frequency Work." To be opened by Dr. W. D. Butcher.
Friday, March 3rd.—At 8 p.m. Junior Institution of Engineers. "Possible Improvements in Locomotive Practice," by Mr. W. Longland.
At 9 p.m. Royal Institution. "Recent Advances in Wireless Telegraphy," by Mr. C. G. Marconi.
At 7.30 p.m. N.E. Coast Institution of Engineers. Consideration of present Board of Trade Regulations for Certificated Marine Engineers.
Saturday, March 4th.—At 7.30 p.m. Glasgow Technical College Scientific Society. "Steam Generators and their Failures," by Mr. G. Nees.
Friday, March 10th.—At 6.45 for 7 p.m. I.E.E. (Manchester). Annual Dinner at the Midland Hotel.

THE ELECTRICAL VOLUNTEERS.

The following orders have been issued for next week:—

Monday, February 27.—"A" Company. Recruits' drill, 6 p.m.; technical instruction, 7 p.m.
Tuesday, February 28.—"B" Company. Recruits' drill, 6 p.m.; technical instruction, 7 p.m. Medical inspection for recruits and Special Service Section, 7 p.m. Lecture on "Electric Lifts," by C. S. M. Cooper, 8 p.m.
Wednesday, March 1.—Instructional drill, headquarters, 8 p.m.; plain clothes; rifles without slings. Submarine mining class, 6–9 p.m. Examination "C" and "D" Companies for "A" badge, 7.30 p.m. Latest date for rendering names of those desirous of attending Easter Camp extended to March 20th.
Thursday, March 2.—"C" Company. Recruits' drill, 6 p.m.; technical instruction, 7 p.m.
Friday, March 3.—"D" Company. Recruits' drill, 6 p.m.; technical instruction, 7 p.m. Lecture, "Some Interesting Facts about Iron and Steel," illustrated by lantern slides and experiments by Lieut. W. H. Merrett, 8.30 p.m.
Saturday, March 4.—Week-end class.

J. H. S. Phillips, Captain,
For O.C.E.E.R.E. (V.)

NOTES.

The B.A. in South Africa.—The annual meeting of the British Association for the Advancement of Science, is to be held in South Africa this year, so that its doings will not excite the same interest in the minds of the public at home as they do under ordinary circumstances. From London to Cambridge in 1904, was a step compared to the journey that will have to be undertaken this year. The meeting is to open at Cape Town on August 15th. Most of the officials and members who are undertaking the trip will leave Southampton on Saturday, July 29th, but some will start a week earlier. The sectional meetings will be held in Cape Town for three days, and in Johannesburg for another three. Including visits to a large number of places of interest, the tour will last about 70 days. The president for the meeting is Prof. G. H. Darwin. Prof. A. R. Forsyth will preside over the deliberations of the Mathematical and Physical Science Section, and Colonel Sir Colin Scott-Moncrieff will be chairman of the Engineering Section. Among the lectures, for which arrangements have been made, will be one on "Physics" by Mr. C. V. Boys, at Cape Town; one by Mr. F. Soddy on "Radio-activity" at Durban; one by Prof. Ayrton, delivered at Johannesburg, on "Distribution of Power;" and at Kimberley Sir William Crookes will discourse on "Diamonds." A fuller account of the proposed doings appeared in the *Times* on February 2nd, 1905.

The King and the Cables.—We read in the *Times* for Wednesday that the King travelled by motor-car to Windsor Castle on the previous day and alighted at the Royal Gardens, where he spent some time inspecting the improvements. His Majesty then drove through the grounds into the grand quadrangle, around the south and west sides of which several labourers were making a trench for the reception of the cable which the Western Electric Co. is about to lay for the electric lighting of portions of the Castle.

Appointments Vacant.—Electrical engineer for the Government of British Honduras ($1,500); permanent way superintendent of Blackburn (50s.); engineer-in-charge (£104) and switchboard attendant (30s.) for Bermondsey.

Nernst Lamps for Street Lighting.—One of our gas lighting contemporaries seems to be sadly perturbed because the Wilmslow Council has adopted street lighting by Nernst lamps in place of gas lighting. Now we should have thought this a small matter indeed, and not worth making so great a fuss about, but we must suppose that there has been a reaction in gas lighting matters since the excitement of the great exhibition and the lack of news relating to gas progress has apparently compelled our contemporary to spread itself out at full length about a comparatively paltry contract which gas has lost. But we should not object to our contemporary filling its pages with matter of this sort if it would only stick to the true facts of the case, and not hunt about for suggestions that the contract has been obtained unfairly. It pretends to know that "a small party" of councillors superficially tested the Nernst lamps in comparison with the flat flame and incandescent gas "one Sunday night." We, however, happen to know that the whole of the councillors were present with the exception of two, and that the inspection took place on a Monday. The mistake in day is a small detail, but it seems to represent our contemporary's standard of accuracy in connection with the whole matter. However qualified or otherwise the Wilmslow Councillors may be to form an opinion respecting the relative failings of incandescent gas mantles and Nernst electrolytic lamps for street lighting, they were all able to see that the estimates showed that with the latter they would effect an annual saving of £29 13s. And if we couple this to our contemporary's statement that they have "adopted a certainty for an uncertainty" (*vide* reprint in local press), what more could we ask them to do? They get what the gas advocate himself calls a certainty, at a reduced cost. Every resident in a street illuminated with incandescent gas finds the darkness made visible by broken or exhausted mantles at times, wind or no wind. It is this "uncertainty" that Wilmslow has decided to do without.

Electricity in Coal Mines.—Mr. John Gerrard, chief inspector of mines for the Manchester and South-East Lancashire district, stated, at a meeting of the Manchester Geological and Mining Society last week, that an official code regulating the use of electricity in mines had been agreed upon, and would shortly be published. Mr. Gerrard (president of the Society) stated that the object of the new rules was to ensure a maximum of safety in working. The employment of electric current as a motive power in and about mines is extending considerably in the Lancashire district.

Institution Notes.—At a meeting of the Glasgow Local Section of the Institution of Electrical Engineers on 14th inst., the discussion on Mr. Maxwell's paper on "Street Arc Lighting" was continued. Mr. W. A. Chamen, the chief engineer of the electricity department, sent a written contribution, in the course of which he said that while the gas engineers a few years ago insisted that street lighting was a very poor business, they now strenuously resisted the progress of electric lighting in our streets. Gas engineers contended that although the electric arc gave brilliant illumination in its own immediate vicinity, the middle region between two arc lamps was poorly lighted, and yet at the same time it was evident that they were doing all in their power to imitate the electric arc by bringing out a gas lamp of high candle power. There was plenty of work for their gas friends to do. Let them confine their energies to the side streets where no electric mains were laid and substitute incandescent gas mantles for the flat flame burner, so that at any rate the light might be sufficient to prevent evening wanderers from coming into accidental collision with the lamp pillars. In main streets Mr. Chamen was sure the arc would continue to the used.

At a recent meeting of the Leeds University Engineering Society, Dr. J. T. Nicolson read a paper on "High-Speed Tool Steel and the Lathes for its Use." He explained that he did not intend to deal so much with high-speed cutting steel as with the forces exercised during the operation of cutting. He alluded to the discovery that tool steel may advantageously be heated up to 2,000° F. if properly cooled afterwards. He analysed the form of a chip cut at dead slow speed, and showed precisely what happens at the point of the tool. Experiment and observation show that 70° is the most effective angle of sharpness, and that to work at high speed, within certain limits, is conducive to the life of a tool. At slow speeds it is the point of the tool that does the work, but at higher speeds the point is kept cool, and the work is done behind the tool point. The lecturer described the dynamometer used in measuring the forces exercised in all directions during cutting. It has been found that stress is constant, whatever the area cut; that the force required to sustain the tool when taking a cut depends upon the point of the tool, quite apart from the form of the cut, and that the force does not depend on the speed of cutting. Dr. Nicolson then proceeded to give particulars of lathes, which he considered most effective and economical.

At a meeting of the members of the Birmingham Section of the I.E.E. on 15th inst., Mr. A. C. Anderson read a paper on the "Application of Electricity to Mines."

The Leeds Branch of the I.E.E. on 16th inst., heard a paper on "Tramways Permanent Way Construction and Maintenance," by Mr. James Lord, of Halifax.

The annual dinner of the Manchester Section of the Institution of Electrical Engineers is to be held on the 10th prox., at 6·45 for 7 p.m., at the Midland Hotel, Manchester.

The Electrical Standardising, Testing and Training Institution.—Prof. C. A. Carus-Wilson, M.A., M.I.E.E., will commence a special course of lectures to the senior students of the above Institution on Monday, March 6th, upon "Direct-Current Motor Construction."

Third-Rail Fatality.—On Monday the body of a young woman named Agnes Maughan was found lying stretched across the live rail, on the New Bridge Street and Tynemouth branch of the North-Eastern Railway between Backworth and Monkseaton stations. Deceased was 18 years of age. Earsdon Grange level crossing is situated about 20 yards from where the body was found. There were marks of burns on the wrists, but the body was not otherwise seriously marked. A train was signalled, and deceased was conveyed in it to Monkseaton, where life was found to be extinct.

London County Council.—At a meeting of the Council on Tuesday, the Parliamentary Committee presented a long report in respect of the electric lighting Bills promoted in the current session for the purpose of securing large and extended powers for supply in bulk, exemption from the purchase clause of the Act of 1888, and other matters. In the opinion of the Committee, the powers sought by the companies were such as to constitute a serious menace to existing and future municipal supply undertakings, and they were persuaded that the magnitude of the proposals, the overlapping powers sought, and the general reversal of the conditions now applying to London, left the Council no alternative but to oppose the Bills. Although the object of the two new bulk supply companies might not be to establish a monopoly, it must inevitably result in that, and the existing companies had introduced Bills mainly, it would appear, in self-defence. It was obvious that a supply for power purposes, and also for the lighting of premises furnished with power, could leave in the hands of the existing authorities, only the residue of the custom. The Committee proposed to report further on the question at a later date after receiving reports from the chief officers, and in the meantime petitions were being presented against the Bills.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*]

Central Station Engineers.—The Electric Light Committee of the Coventry Corporation has reconsidered the application of Mr. J. A. Jeckell, the manager of the Electricity Department, for an increase of salary, and has decided to adjourn it until after the issue of the balance-sheet for the past year's trading. This is considered by many to be unfair, inasmuch as Mr. Jeckell was, at the time of his appointment, distinctly promised an advance if he converted the concern from a loss to a profit, and this he has accomplished.

Mr. C. F. Butler, A.M.I.E.E., managing engineer to the North Metropolitan Electric Power Supply Co. at their Hertford power station, has been promoted to a similar position at the Wellingborough power station of the County of Northampton Electric Power and Traction Co.

On Tuesday last week the staff of the Heston and Isleworth Electricity Works met to make a presentation to Mr. J. R. Wilson, shift engineer, on the occasion of his marriage. Mr. Bond, chief engineer, asked Mr. Wilson to accept the present, a quarter-chime clock, as an evidence of the good feeling which existed in the works. Mr. Sykes, chief assistant engineer, asked Mr. Wilson to accept for his wife a pair of silver serviette rings, also from the staff.

Salford T.C., on February 15th, adjourned to the March meeting the following increases of salary recommended by the Electricity Committee:—Mr. C. D. Taite, electrical engineer, from £700 to £750 per annum; Mr. E. H. L. Dickson, mains superintendent, from £250 to £275; Mr. J. Collinge, mechanical engineer, from £182 to £208; Mr. H. Davidson, engineer-in-charge, from £160 to £170. The following tramway officials' salaries were increased:—Mr. E. Hatton, general manager, from £500 to £550; Mr. G. W. Halford, chief clerk, from £200 to £225; and Mr. C. H. Chester, traffic superintendent, from £200 to £220.

Warrington T.C. has, by 15 votes to 13, rejected a recommendation by the Electricity and Tramways Committee, that the salary of Mr. J. Telfer, tramways manager, should be increased from £120 to £140 per annum. Other recommended increases of salary, viz., Mr. F. V. L. Matthais, electrical engineer, from £250 to £300 a year, Mr. F. W. Purse, assistant electrical engineer, from £156 to £169, and Mr. W. E. Rogers, mains engineer, from £130 to £143, were referred back to the Committee.

Hastings T.C. on Friday decided, on the recommendation of the Electricity Committee, to allow the borough electrical engineer to take three articled pupils instead of two at any one time until July 6th next.

The Stalybridge, Mossley, Dukinfield and Hyde Joint Tramways and Electricity Board has increased the salary of Mr. R. Blackmore, engineer, from £350 to £450 per annum, and that of Mr. F. Schofield, commercial manager, from £250 to £300 per annum.

Mr. W. W. Alston, second engineer-in-charge at Bermondsey, has been appointed chief assistant engineer to the West Bromwich Electricity Department. Mr. H. B. Shutes, third engineer-in-charge at Bermondsey, has been promoted to the vacancy caused by the departure of Mr. Alston.

Mr. A. W. Empson, works superintendent at the Maidstone Corporation Electricity Works, has left to take up a more important appointment with the Mexican Gas and Electric Light Co., Ltd.

The Wishaw T.C. has appointed Mr. Ernst F. Cox, assistant electrical engineer at Hamilton, to be borough electrical engineer.

The Battersea Borough Council appointed, on Wednesday, Mr. W. A. Kemm, chief assistant electrical engineer, Battersea, to be chief electrical engineer. There were 63 candidates. The final voting was:—Mr. Kemm, 27; Mr. A. H. Foyster (Edinburgh), 18; Mr. John McMillan (Falkirk), 1.

Mr. H. Morley Lawson has resigned his present position as assistant electrical engineer to the Bournemouth Corporation Tramways Department. On Friday, February 17th, Mr. J. Bulfin, borough electrical engineer of Bournemouth, presented Mr. Lawson with a gold albert on behalf of the generating station staff.

Tramway Officials.—On Friday last Mr. F. Gill, senior cash clerk (who is severing his connection with the Huddersfield Corporation Tramways after 21 years' service), was presented with a gold curb albert with engraved medal attached. Mr. R. H. Wilkinson, general manager, presided, and was supported by Mr. T. Hartley, traffic superintendent, and other heads of departments. Mr. I. Pogson, motorman, one of the oldest employés, made the presentation.

The Recreation Club, in connection with the Electrical Engineers' Department of the Hull City Tramways, held its first smoking concert on Friday, February 17th. Mr. J. Wilkinson, M.I.E.E., was in the chair, supported by Messrs. W. T. Robson (chief assistant engineer), D. Joys, T. Palmer (secretary) and others. The chairman said that the future of the tramways in Hull looked very bright, and when the proposed extensions were finished, many more men would be employed. The toast of "The Mayor" (Alderman F. Larard), who is president of the Club and chairman of the Tramways Committee, was responded to with musical honours. The club has only just been inaugurated. The attendance at the concert was 250.

The Bradford City Council had a lengthy discussion the other day, in the course of which a good deal of ill-feeling was given vent to on a resolution moved by Mr. Swithenbank that Mr. C. J. Spencer, the tramways manager, be requested to send in his resignation, and that another manager be advertised for. Mr. Spencer was appointed in 1898 at £150 per annum, and his salary was raised year by year, until in 1903 it was increased to £700. From what we can gather, the chief offence with which Mr. Spencer is charged is his putting in for the Newcastle appointment. Mr. Spencer's last agreement with Bradford has five months to run. The resolution was defeated by 31 votes to 16. Really the ways of some municipal councillors are hard to understand. To suggest that a Corporation official may not put in for an appointment somewhere else until his existing agreement has run right out is the very height of absurdity.

The following increases in the salaries of officials in the Tramways Department are propcsed by the Highways Committee of the London County Council:—Mr. J. Welling, permanent way engineer, from £450 to £475 a year on April 1st, 1905, and to £500 a year on April 1st, 1906; Mr. H. Vorley, accountant, from £350 to £400 a year; Mr. H. Holland, paymaster, from £250 to £280 a year; Mr. C. R. Johnson, assistant traffic manager, from £235 to £250 a year; and Mr. J. Glover, superintendent of claims, from £225 to £250 a year.

General.—On February 13th, at the works of Messrs. Willans & Robinson, Mr. Ralph W. Birkett, electrical engineer to the company, was presented with a watch and a spirit cabinet from the staff and workmen as tokens of esteem on his leaving the Ferry Works. Mr. G. F. L. Clayton East, general manager, made the presentation.

On Thursday, 16th inst., as hon. secretaries to the Musgrave Heaphy Testimonial Committee, Messrs. S. G. O. Russell and Albion T. Snell travelled to Brighton, and presented the gold watch and chain, album of signatures and engrossed address, to Mr. Musgrave Heaphy, as arranged at the meeting of subscribers held on 27th ult. Mr. Heaphy, in acknowledging the presentation, referred to the great honour that was done him by the presentation of such an address and testimonial, emanating from both the electrical and insurance professions as well as from the Phœnix Assurance Co. He wished the deputation to express to all concerned the intense gratification and pleasure their extremely kind and sympathetic action had given him. As long as he lived the address and testimonial would be to him the source of the greatest pride and satisfaction.

It is stated that Mr. Marconi's marriage will take place in London on March 16th at the Roman Catholic Church of St. George's, London.

Obituary.—English electrical men who took part in last year's Institution visit to St. Louis, will learn with deep regret of the sudden death of Mr. E. H. Mullin, a well-known American technical journalist, to whom they were indebted for many kindnesses during the time of their stay on the other side. Mr. Mullin was born in County Tyrone, Ireland, in 1859. For many years he was engaged in literary work on some leading newspapers in the States, but he had a leaning toward technical journalism, in which he achieved great distinction. In 1898 he became head of the Publicity Department of the General Electric Co. of America. He had for many years taken part in the conventions of electrical and other technical bodies, and at the time of the St. Louis International Electrical Congress he carried out some excellent organisation duties in connection with the special train to St. Louis, in which the American Institute and so many foreign visitors made a circuit of the country. The members of the British party, recognising under what a deep debt of gratitude they stood in relation to Mr. Mullin, presented a handsome silver service to him and Mrs. Mullin before their return home. Mr. Mullin died suddenly on January 25th while sitting at home reading. Heart disease was the cause.

ELECTRICITY SUPPLY ACCOUNTS.

Liverpool Municipal Electricity Supply.

THE returns of the Liverpool electric supply undertaking given herewith, are for the financial year just completed; as in previous years the department maintained a steady and satisfactory progress. The units sold during the past five years have been as follows:—1900, 11,564,335 units; 1901, 20,018,142 units; 1902, 23,186,083 units; 1903, 26,015,062 units; and 1904, 29,333,623 units. During the year an additional £30,000 revenue was earned with only £1,000 extra working expenditure; the gross profit, of course, proportionately benefited, and after meeting financial charges, &c., some £44,000 balance remained to the good. This was disposed of, as to £16,286 to the reserve fund, £11,290 to renewals, and a contribution to the rates of £16,934. The total amounts credited to reserve and renewals stand at £75,557 and £59,327 respectively.

An analysis of the working costs is appended below.

The prices charged are:—Private lighting, 3¾d. and 3d. per unit, for up to and above 3,000 units consumption per quarter respectively; power, 2d. and 1½d. per unit, on similar terms to the lighting; traction, 1·12d. per unit plus 5 per cent. for each 1s. paid for coal in excess of 5s. per ton; public lighting, 2d. per unit. The resident electrical engineer is Mr. Alfred Clough, A.M.I.C.E.

GENERAL STATEMENT.

For year ending December 31st—	1904.	1903.
Total capital expended	£1,718,713	£1,553,808
Number of units sold—		
Private supply	10,069,856	8,697,474
Public lighting...	284,634	274,837
Traction...	18,979,133	17,042,751
Total number of units sold ...	29,333,623	26,015,062
Equivalent No. of 8-c.p. lamps connected	583,430	525,812
H.P. of motors connected	—	4,234
Number of public lamps	189	189
Maximum load in KW.	14,093	12,600
Revenue Account—		
Gross revenue	£236,404	£206,311
„ expenditure	£99,800	£98,775
„ profit	£136,604	£107,536
Average price obtained per unit—		
Private supply	3·3d.	3·3d.
Public lighting	2·0d.	2·0d.
Traction	1·16d.	1·1d.

REVENUE ACCOUNT FOR YEAR ENDING DECEMBER 31ST, 1904.

Gross revenue ... ... £236,404 = 1·94d. per unit.

WORKS COSTS, &c.

	1904. Gross.	1904. Per unit.	1903. Per unit.
Coal	£36,013	·29d.	·34d.
Oil, waste, water and engine room stores	5,199	·04d.	·06d.
Wages incurred in generation and distribution...	16,828	·14d.	·16d.
Repairs and maintenance of buildings, machinery and plant ...	11,905	·10d.	·11d.
Works and distribution costs ...	£69,945	·57d.	·67d.
Rent, rates and taxes	16,432	·14d.	·11d.
Management expenses, including salaries of engineer and clerical staff	8,273	·07d.	·07d.
General establishment charges, insurance, law, printing and stationery	5,150	·04d.	·05d.
Total working costs	£99,800	·82d.	·90d.

PROFIT STATEMENT, 1904.

Interest on loans, &c.	£53,775
Sinking fund	38,362
Provision for bad debts	114
Balance on year's working...	44,510
Interest brought forward	157
Gross profit	£136,604

CITY NOTES.

City of Carlisle Electric Tramways Co.

THE report for the year ending December 31st, 1904, states that the revenue account shows a surplus of £2,949, being a decrease of £68 as compared with last year; and the balance of profit and loss account, after prov ding for debenture stock interest and debenture stock trustees' remuneration is £1,555. Of this, it is proposed to carry £500 to depreciation, raising that fund to £3,068 13s. 6d.; and to carry forward £1,055.

The car-miles run were 359,756; the number of passengers carried 2,935,002; and the total receipts amounted to £10,713, being increases of 25,363 miles run, 129,725 passengers carried, and £435 in receipts respectively. Although the result of the experiment of continuing the 10-minutes' service during the winter has resulted in an increase of traffic receipts, it has caused a larger increase in expenses, and the net result being financially so unsatisfactory, the directors have felt reluctantly compelled to discontinue that service for the early months of this year.

The revenue account shows an expenditure of £7,765, the items being electrical energy purchased £2,508, running expenses £3,758, maintenance and repairs £498. The revenue was:—Traffic receipts £10,200, parcel receipts £222, advertising receipts £253, sundry receipts £8, bank interest £30. This is a total of £10,713, which leaves a balance of £2,949.

Imperial Tramways Co.

THE directors' report for the year 1904 gives the following particulars:—

MIDDLESBROUGH, STOCKTON AND THORNABY ELECTRIC TRAMWAYS.—The gross receipts amounted to £51,097, and the number of passengers carried was 9,818,349, compared with totals of £49,963 and 9,576,125 in the preceding year. The net profit for the year is £16,665. The Bill promoted last session received the Royal Assent on August 15th last. Under it the company is empowered to construct a line of tramway 4 miles 4·70 chains in length, commencing at the termination of the company's existing system in Middlesbrough and running through the populous manufacturing districts of North Ormesby, South Bank, Grangetown and Eston. These tramways, with the exception of a short piece of line a quarter of a mile in length, are not purchasable by the local authorities until 1929, and then only on the terms of paying the fair market value as a going concern, instead of the terms laid down in the Tramways Act, 1870. The Act also authorises the conversion from single to double track of a portion of the company's existing line in Thornaby, near the Race Course, which will greatly facilitate the handling of the heavy race and football traffics. In connection with this Act of Parliament, the company have entered into an agreement with the Corporation of Thornaby, under which the latter have undertaken not to exercise any rights of purchase with regard to the existing lines until the expiration of the normal period of 21 years from their authorisation, namely, in 1918. Under the company's order of 1897, power was also given to the local authorities, provided they all combined, to acquire the undertaking in 7 or 14 years, although on terms more advantageous to the company. The effect, therefore, of the new agreement with the Thornaby Corporation, they being one of the authorities, is to render that alternative provision inoperative.

LONDON UNITED TRAMWAYS (1901) LTD.—The company's interest in this important undertaking has been slightly increased during the past year, and is now represented by 44,446 fully paid 5 per cent. cumulative preference £10 shares. There is a corresponding increase in the dividends on these shares, which amount for the year to £21,135 0s. 1d. net, as shown in the revenue account.

The company's net revenue account for the year shows an available balance of £41,656, and after payment of interest on the debenture stock for the whole year, and interim dividends on the preference and ordinary shares in respect of the half-year to June 30th last, amounting together to £26,168, it is proposed to appropriate the balance as follows:—Dividend at 6 per cent. per annum on the preference capital (paid on January 2nd last) £5,700; final dividend at 10 per cent. per annum (making 9 per cent. for the year) on the ordinary capital (less income-tax), £9,500; and to carry forward to the next account £287 10s. 8d. The reserve funds now amount to £121,871 14s. 7d.

Newcastle-upon-Tyne Electric Supply Co.

THE directors' report for the year 1904 shows that the total units sold amounted to 17,132,153, which, compared with the previous year's figures of 9,033,625 units, shows an increase of 8,098,528. Of the units sold in the past year, 14,000,000 have been sold for power purposes, the remainder being for lighting only. The profits for the year, including the balance of £1,099 brought forward from 1903, amount to £62,539, out of which there have been paid:—Interest on debentures and loans, £14,257; interim dividends, paid in July last, of 2½ per cent. on the amount called up on the whole of the preference and ordinary shares, £14,278; and the balance of extra cost in connection with the electrical undertaking purchased from the Walker and Wallsend Union Gas Co., £1,500 = £30,035; leaving an available balance of £32,504, which the directors recommend should be appropriated as follows:—

Further dividend of 2½ per cent. on the preference shares, and of 5½ per cent. on the ordinary shares (other than those mentioned below), making total dividends of 5 per cent. and 8 per cent. respectively for the year = £24,405; dividend of 3½ per cent. on the ordinary shares allotted in connection with the purchase of the Walker and Wallsend Union Gas Co.'s electricity undertaking, making 6 per cent. as per agreement, £1,227; to depreciation account, £6,000 = £31,632; leaving to be carried forward to next year, £872 8s. 11d.

During the latter half of the year, the North-Eastern Railway Co. has been regularly supplied with electrical energy for traction, as well as for power and lighting purposes. The amount standing to the credit of reserve has been increased by the premiums received on shares issued during the past year amounting to £23,470, bringing it up to £49,920. From this there have been deducted expenses of the share issue (1904), £409; costs in connection with the opposition to the Newcastle Corporation Bill during last Session, £2,892; portion of Priestman Power Co.'s preliminary expenses written off, £364; leaving £46,256. Of this amount £25,000 has been transferred to depreciation account, in addition to the £6,000 before-mentioned, leaving a balance standing to reserve account of £21,256, which will be increased to £24,772 by a further sum of £3,517, representing the proportion of premiums payable with the final call on the new shares, which became payable on the 15th inst. The depreciation account will, by the additions recommended, amount to £131,000. The total expenditure on capital account during the year has been £124,242, representing outlay in completing the new power station at Carville, as well as other developments in the company's area. The Carville station, the construction of which began in 1903, was put into commercial operation during the latter half of the year. The company has had alloted to it 10,000

shares of £1 each, now fully paid, in the Priestman Power Co., Ltd., representing one-half of the total share capital of that company. The Priestman Power Co.'s generating station at Blaydon Burn has been erected, and is now supplying current; the development of the business generally in that district is being pushed forward. An agreement has been entered into with the Northern Counties Electricity Supply Co., Ltd., by which the working and developing of the districts of Whitley, Monkseaton, Earsdon and Seghill, covered by provisional orders granted to that company, have now been transferred to this company. The supply of electricity in Whitley and Monkseaton has been available for some time, and it is expected that this area will be a profitable acquisition to the company's business. The payment of £13,685 made to the Northern Counties Co. is for the provisional orders, plant, cables, &c., in the above-mentioned districts.

The shareholders will be asked at the meeting to confirm a provisional agreement which has been entered into for the purchase of the whole of the shares issued by the County of Durham Electrical Power Distribution Co., Ltd. This scheme, if sanctioned, will largely increase the company's output, and, being a matter of special importance, forms the subject of a separate report, which will be in the hands of the shareholders before the meeeting. The additional share capital issued during the past year was, after consideration by the directors, offered to the shareholders as in previous years, when the whole amount was taken up by them or by their nominees, the preference shares being issued at a premium of 10s., and the ordinary shares at a premium of £1, per share. Representations having been made to the directors as to the desirability of a quotation of the company's shares on the London Stock Exchange, an application has been made to secure such a quotation, and certain alterations will be necessary in the articles of association to comply with the Stock Exchange rules and regulations. A resolution will accordingly be submitted at an extraordinary general meeting to be held after the ordinary general meeting. Larger office accommodation having become necessary owing to the growth of the business, convenient premises were secured, and the registered office of the company was removed at the end of last year to Royal Exchange Buildings, Hood Street.

Hart Accumulator Co.

The directors' report to December 31st, 1904, says that the profit was £5,813, and the balance brought forward £5,738. After deducting the dividend on preference shares, £138, the balance standing to the credit of profit and loss account was £11,413. The directors recommend a dividend of 12½ per cent. per annum on the ordinary share capital, which will absorb £5,000, leaving £6,413 to be carried forward. The company's buildings, plant, tools, &c., have been augmented by £4,262, which has been charged to capital, and due depreciation on same has been made. The maintenance of the works, plant, &c., has been well kept up at a cost of £800, which has been paid for out of revenue.

National Electric Supply Co.

The meeting of this company was held recently at Preston, Mr. J. Booth presiding.

The Chairman called attention to the increased business for the year, notwithstanding the depression in trade, necessitating great economy on the part of many consumers, and also the bright weather in the autumn, when an unusually small amount of artificial light was required. The receipts for current amounted to £21,037, as against £19,462 in the previous year. They had spent about £300 more than before on repairs and maintenance. Rates and taxes had been increased from £872 to £1,776. They had made an appeal against the assessment, but did not yet know the result. The extra £903 represented a sum sufficient to pay an extra dividend of 1s. 1d. a share on the ordinary shares and £3 on each of the founders' shares. Dividends of 4 per cent. for the year on the preference shares and 5s. per share on the ordinary shares for the half-year, making, with the interim dividend paid in July, 8s. per share for the year; also a dividend of £2 14s. 3d. per share on the founders' shares, were declared.

Chelsea Electricity Supply Co.

The annual meeting was held on Wednesday at Winchester House, Mr. J. Irving Courtenay presiding.

The Chairman, in proposing the adoption of the report, after referring with regret to the death of Major-Gen. C. E. Webber, one of the original directors of the company, said it was satisfactory to be able to report a further improvement in the company's position. They were paying ½ per cent. more than the previous year, making 6 per cent. for the year. The capital expenditure, £10,829, was small, and was partly due to a less expenditure in mains—the result, to a certain extent, of the change to the higher voltage. The total working costs per unit were practically the same, notwithstanding the fact that there was a considerable increase in the amount spent on maintenance of plant. The average price of coal during 1904 was much the same as in the previous year, the reduction in price amounting only to 1 per cent. The increase in the output was satisfactory, and this was only partly due to the foggy weather which was experienced in the last two months of the year. There was a considerable increase in the use of their supply for motive power, heating, and for charging batteries of electric carriages, &c. The number of lamps added during the year was 15,424, which was not so good as in 1903, when 19,233 lamps were added. The addition, however, was about the average of several years past, and the previous year's figure was unusually high. The total lamp connection at the end of the year was 210,659. The equipment of their generating station at Alpha Place had been completed, and there was no further room for additional plant in that building. To cope with the prospective increase in the demand for a supply of electricity, it had become necessary to provide for an extension of their generating works on the land adjoining that station, which they had already acquired for that purpose under the powers of their special Act of Parliament. He would remind the shareholders that, under this special Act, they took powers to acquire sites which they estimated would be sufficient to serve for the extension of their business for many years to come. Some exception was taken to that policy at the time, but subsequent experience had amply proved that the policy then adopted was prudent and wise. To provide for the further generating power that was required, the building of a section of a new generating station in Manor Street, adjoining the present Alpha Place station, would be carried on during the current year, and the chimney shaft for that purpose was already well in hand. The equipment of those works would follow gradually, and the expenditure on the additional plant would only be incurred from time to time as the necessity for further power arose. The alterations in their system of supply which had been carried out during the last two years had led to a marked improvement in the efficiency of their distribution. The adoption of a higher pressure of supply had enabled them to distribute direct from the generating station over a large portion of the area; the considerable losses of transformation at sub-stations were thus obviated, and an important saving in capital expenditure was also effected. They proposed to continue the development of this direct supply system in all cases where it could be done with advantage. The work of altering their mains and machinery to render them suitable for use at the higher pressure of supply was necessarily of a somewhat difficult nature, as it had to be carried out without any interference with the service to the public. The cost of this work, as well as the cost of changing over to the 200-volt supply the earlier customers who were supplied at 100 volts, had been considerable. He was happy to state, however, that the great bulk of the expenditure under this head had now been incurred, and they hoped to derive in the future a substantial advantage from the alterations which had been carried out. The increase in the sale of units was satisfactory, the total being 3,212,412, or 473,060 more than last year, and the units sold per lamp were 15·25, against 14·05. The issue of the debenture stock had brought in premiums which, after deducting the cost of issue, amounted to £1,664, which had been carried to a debenture stock premium reserve fund. As they were aware, the Bill for the extinction of the founders' shares upon certain terms had been passed at extraordinary general meetings of all classes of the shareholders, and there was no opposition to the Bill in the House of Commons.

Mr. G. N. Martin seconded the resolution, and the report was adopted.

Subsequently extraordinary general meetings of the ordinary shareholders, and of the holders of founders' shares, were held, at which the resolution approving of the Bill for the extinction of the founders' shares was confirmed.

Westminster Electric Supply Corporation.

The ordinary general meeting of shareholders of this company was held on Wednesday, at the offices, Eccleston Place, Eccleston Square, Mr. E. Boulnois, M.P., presiding, in the absence through indisposition of the chairman, Lord Suffield.

The Chairman, in proposing the adoption of the report, said he thought they would all agree that it was of a highly satisfactory character. They had increased the equivalent of 8-c.p. lamps by some 50,000 during the past year, which brought up the total number to 711,679, and applications continued to come in at a satisfactory rate. The station of the Central Electric Co. at St. John's Wood had been working well during the year, and had supplied a large amount of current to them at a considerably lower rate than in the previous year. He thought the shareholders would agree that it was a wise step which the board took when they associated themselves with the St. James' and Pall Mall Co. in starting a great central station in a very central part of London. The Central Electric Supply Co. was practically the only bulk supply company which existed in London, and they had thought it right to promote a Bill in Parliament this year to obtain, if possible, additional powers. The future of the Westminster Co. was closely allied with that of the Central Co. The Central Co. had a large area of ground only partially covered at present, and there were opportunities there for erecting more stations on a very large scale. The new transformer station at Duke Street Gardens was not yet quite complete, but arrangements had been made for a part of the space to be available for the engineers, and operations had been going on there since the latter part of last year. As to the dividend, he did not think the shareholders would complain of the amount to be distributed, and he was quite sure they would agree that it was a wise thing to keep a substantial balance in hand. Already, from the commencement of the year, they had lowered the price of current somewhat, and they believed that in doing that, it would ultimately lead to more business. It was, of course, possible that the receipts might at first be affected to some extent, and with that idea in their minds they had thought it wise to keep a substantial balance in hand. He wished to utter a word of warning. He did not wish to frighten the shareholders, but he thought they should understand that a Bill had been lodged in Parliament called the Administrative County of London and District Electric Power

Bill, which proposed to supply the whole of London with electricity for power purposes. He thought it was very hard that such an attempt should be made upon the companies in London who had borne the burden and heat of the day, and who had been at considerable trouble and enormous expense in bringing their systems to perfection for supplying the public with the commodity at a most reasonable rate. This company proposed to come in and take all the plums and obtain an area over the whole of London for the supply of power. When they started, they were placed under obligations and restrictions by Parliament. By the present Bill this proposed new company would be under no obligations to supply at all, and there would be no restrictions for a term of years as applied to the other companies. They would also be free from other obligations under which the existing companies were placed when they started business. They would oppose the Bill in the interests of the shareholders at every point, and would do their utmost to bring about its defeat. By the irony of fate, they had now on their side the L.C.C. and the municipalities who were also suppliers of electricity; and with the aid of the other electric supply companies in London, they hoped to prevent the Bill, which he thought would be a great injustice to the existing companies, being allowed to pass.

Mr. W. HAYES FISHER, M.P., seconded the motion, and the report was adopted.

Northampton Electric Light and Power Co.

THE annual meeting was held recently, Mr. F. H. Thornton, J.P., presiding.

The CHAIRMAN said the accounts were even better than they appeared, for they were allowing £600 more for depreciation, and carrying forward £316 against £209. [The report appeared in our last issue.] They had greatly improved their machinery. The new 5 per cent. preference shares had all been taken up, and the ordinary shares had been well applied for. They proposed in the near future to pay off the 6 per cent. preference shares, which would cost £800; and then, when they had a little more money, to write off the founders' shares, which would cost another £1,000. The figures would have been even more satisfactory had trade been brisker. With regard to the offer of the Town Council to purchase the undertaking, that never seemed to be serious, and there was never any offer worthy of laying before the shareholders.

The report was adopted.

South Metropolitan Electric Light and Power Co.

THE directors' report for 1904 shows a credit balance of £16,575, which with £5,220, the balance brought forward from the previous year, makes a total of £21,795. After deducting £6,324 for interest on debenture stock paid and accrued, and for other interest, and £1,750 for interim dividend paid on 7 per cent. cumulative preference shares, there remains a balance of £13,721, which the directors propose to deal with as follows:—

Final dividend to December 31st, 1904, upon the amounts paid up on the 7 per cent. cum. pref. shares, £2,439; to depreciation account, £2,250; to write off change-over system in Greenwich account, £825; in reduction of preliminary expenses account, £1,500; balance carried forward, £6,707—Total, £13,721. The business continues to make satisfactory progress, as will be seen by the following comparative figures:—

Year	8-c.p. (35-watt) lamps. Connected at end of year.	8-c.p. (35-watt) lamps. Increase.	No. of consumers.	Gross revenue. £ s. d.	Expenditure £ s. d.	Net revenue. £ s. d.
1900	14,473	14,473	342	4,195 2 1	4,050 4 2	144 17 11
1901	29,449	14,976	746	7,808 9 7	5,658 5 4	2,150 4 3
1902	44,916	15,467	1,234	14,334 5 2	6,978 13 10	7,355 11 4
1903	60,540	15,624	1,734	19,450 4 10	8,409 0 0	11,041 1 10
1904*	108,391	47,851	2,555	28,796 16 6	12,222 0 3	16,574 16 3

* Including Crystal Palace Co.'s area from June 16th, 1904.

The company took over the undertaking of the Crystal Palace District Electric Supply Co. on June 16th last; the number of lamps added by the inclusion of this area was 29,572, and the accounts submitted include the returns of this business from that date. The change of system from direct to alternating current in the new area is being carried out as rapidly as possible, and should be completed before the end of the present year, when the company will benefit by more economical working. The Urban District Council of Beckenham have served notice on the company, exercising their statutory right to purchase a small portion of the new area, and the purchase price is now being adjusted. In accordance with the authority conferred by a special resolution passed March 15th, 1904, the directors proposed to the debenture stockholders to surrender their extended right of conversion into preference shares and allow the stock to be increased to an amount not exceeding the issued and paid-up share capital for the time being, receiving as consideration for these concessions the following rights:—(1) To exchange at once into preference shares at par; (2) to receive new debenture stock equal to 25 per cent. of the amount not so exchanged. The arrangement has since been carried through, and the amount of the consideration, less the net premiums received on a subsequent issue of preference shares, has been carried to a suspense account in the balance-sheet. The effect of the arrangement will be a saving of about £1,300 per annum in the prior charges. During the year a further £50,000 4½ per cent. debenture stock and 30,000 preference shares of £1 each, were offered to, and subscribed by, the proprietors. The directors have appointed Mr. William May as an additional director.

National Telephone Co.

THE directors report that the income accrued in respect of the business of the half-year ended December 31st, 1904, amounts to £1,033,706, as compared with £941,260 for the corresponding period of 1903, being an increase of £92,446. The working expenses for the half-year amount to £591,636, as compared with £527,284 for the corresponding period of 1903, being an increase of £64,352. The net result for the half-year (after deducting the Post Office royalties amounting to £95,195) is a profit balance of £346,875, as compared with £327,739 for the corresponding period of 1903, being an increase of £19,136. The rentals carried forward for unexpired terms of running contracts, amount to £889,578, as compared with £827,164, at the corresponding period of 1903, being an increase of £62,414. Out of the available balance of £274,058 shown by the net revenue account the board will recommend the payment for the half-year of a dividend at the rate of 6 per cent. per annum on the first and second preference shares, 5 per cent. per annum on the third preference shares, 6 per cent. per annum on the preferred stock, and 5 per cent. per annum on the deferred stock, less income-tax, in all cases. The board also propose to transfer £115,000 to the reserve fund, and to carry forward the balance of £10,141. The sum of £402,101 has been expended on capital account during the half-year in the erection of 18,625 additional exchange and private stations, and in the construction of underground works. The board after protracted negotiations have arrived at an agreement with the Postmaster-General for the sale to him on December 31st, 1911, of the undertaking of the company, which agreement is subject to the approval of Parliament.

Edwards Air Pump Syndicate.

THE directors' report for the year 1904 states that the royalty income was £9,489, as compared with £7,493 for 1903, an increase of £1,996. The ordinary expenditure was £3,700, being an increase of £572 on the previous year. The revenue from royalties during the past year shows a satisfactory increase due to steady development of both the home and foreign business of the syndicate. The royalties from foreign countries amounted to £2,216, or 23 per cent. of the total royalties for the year. During the past year 1,046 pumps were booked; of this number 626, or 60 per cent., were for land installations and 420, or 40 per cent., were for use with marine engines.

The depression in shipbuilding continued during 1904, but there is every prospect of renewed activity in this branch of industry during the current year. A large number of Edwards pumps have been fitted in connection with turbines of the Parsons, Curtis and De Laval types, and extremely good results have been obtained. Eleven turbine steamers have been fitted with the Edwards pump. The British Admiralty have adopted the Edwards pump for all the electric lighting and power plants with which the Government dockyards in various parts of the Empire are now being equipped. Over 1,500 steamers have now been fitted with the Edwards pump, and it has been adopted for more than 200 of the principal electric lighting and traction stations in Great Britain and the United States.

An interim 5 per cent. dividend was paid in July, absorbing £1,014, and there has been set aside for capital redemption fund, £2,250; equalising dividend account, £500; investment reserve, £147; and depreciation, £56. It is proposed to pay a further dividend of 10 per cent., making, with the interim dividend, 15 per cent. for the year, absorbing (less tax) £2,029; leaving to be carried forward, £549.

Baker Street and Waterloo Railway Co.

THE half-yearly meeting of the shareholders of this company was held on 16th inst. at Hamilton House, Victoria Embankment, Mr. Theodore Julius Hare presiding.

In proposing the adoption of the report, the CHAIRMAN said that the expenditure on capital account during the half-year had amounted to £173,133. The estimate of further expenditure on capital account was £1,706,895, of which about £600,000 would be disbursed during the present half-year. The assets amounted to £1,789,895 17s. 9d. Their works between the Elephant and Castle and Harewood Avenue were nearing completion. The running tunnels were completed between those points and all the tunnels were completed except one at the Elephant and Castle, and half the permanent way had been laid. The underground work at the stations was progressing, and some of the buildings above ground had been commenced, and should be finished in good time, as the weather was not now likely to interfere with building work. At the depôt the work generally was well in hand, and the shops and carriage sheds were well on towards completion. West of Harewood Avenue, in the Paddington direction, the land for the stations at Lisson Grove and Edgware Road had all been purchased, and had been in the possession of the contractors for some time. At Edgware Road one of the lift shafts and the stair shaft had been sunk, and the running tunnel was being driven from this point eastwards. An interchange subway had been arranged with the Great Central Railway Co. between their Marylebone station and that company's Lisson Grove station. In view of the fact that the Great Central Co. would shortly be running trains into their Marylebone terminus over some 80 miles of suburban lines, the exchange of traffic with this company should before long be of considerable magnitude. As regarded equipment, work preliminary to fixing the lifts had been started, several of the stairways had been placed in position, and the arrangements for secondary lighting, ventilation and signalling were well in hand. The high-tension cables from Earl's Court along the District Railway to the sub-stations on this company's line were now three quarters complete; 18 trains, composed of two motor-cars and four trailer cars, also trucks, motors and controlling apparatus were on order, and delivery should commence in May. They expected to have the line between the Elephant and Castle and Baker Street ready to open for traffic before the end of this year, and they were satisfied that, when completed, they would have a first-class undertaking, with all the most up-to-date improvements, so that it would not only be safe, comfortable and cheap

for the travelling public, but capable of being worked at very low cost, and further in view of the exceptional facilities it would give as a through North and South route, and considering the large number of points at which it would exchange traffic with other railway systems, there would be a very large number of passengers indeed carried on it. Mr. Stephen Sellon, one of the leading tramway experts in this country, who was exceptionally competent to form an opinion, estimated the number of passengers at 35 millions annually. They had, doubtless, noticed that Messrs. Speyer Bros. had the previous day offered for sale £500,000 of this company's 4 per cent. debenture stock which they had purchased from the Underground Electric Railways Co. of London, the contractors. This issue was most successful, and the applications were so numerous that the lists were closed in the afternoon instead of being kept open till the following Saturday as originally intended. A Bill had been deposited in Parliament seeking power to alter the arrangement of the subway at Trafalgar Square, and the subway at the Elephant and Castle from their station to the City and South London station, and for additional time for the completion of the works and purchase of land. Representations having been made to the board by the financiers interested in this undertaking, that it would greatly facilitate dealings in the stock and improve its market value if the company could issue debenture stock certificates to bearer, clauses had been included in the Bill with this object. Several Bills had been deposited affecting this company, and they were being carefully watched in their interest. The Royal Commission on London Traffic had not yet issued its report, and it was at present doubtful if any of the Bills for new tube railways would be proceeded with this Session.

Sir Algernon West seconded the motion, and the report was adopted.

Subsequently a special meeting was held, when resolutions were carried approving of two Bills which the company is promoting in Parliament.

Telegraph Construction and Maintenance Co.

The report for 1904 shows a net profit of £48,825, after charging interest on debentures. To this must be added £120,483 brought forward from last year, making a total of £169,309. The directors propose to distribute a dividend of £1 4s. per share, being at the rate of 10 per cent., and making, with the amount already paid, a total dividend for the year of £1 16s. per share, or 15 per cent., leaving £102,079 to be carried forward. Various lengths of cable have been manufactured, and sundry cable-repairing operations have been carried out, but the work generally has not been on so extensive a scale as during the past few years. Advantage has been taken of the slackness of work to rebuild a portion of the factory at Greenwich and to introduce improvements there which will add to the efficiency of the works. The directors have contracted for the building of a new cable-steamer. She was launched in the Tyne on November 22nd, and is named *Cambria*. Her tonnage is 1,955.

Oxford Electric Co.

The directors' report for 1904 says that the revenue account shows a profit (including £831 brought forward) of £11,803. After providing £2,051 for debenture and other interest and writing off £608 on account of hire-purchase installations, the balance available for dividend is £9,144, which the directors propose to appropriate as follows:—In payment of a dividend at the rate of 7 per cent. per annum, free of income-tax, on the share capital ranking for dividend (whereof 2½ per cent. was paid in September last), £5,775, and in adding £2,470 14s. 8d. to the reserve and renewal of plant account, which will then amount to £8,500; the balance of £898 10s. 7d. to be carried forward to next year's account. It is estimated that at December 31st last there was the equivalent of over 65,000 8-c.p. lamps connected to the mains. The number of Board of Trade units sold during 1904 was 13 per cent. larger than in the previous year. The new capital has been expended principally in erecting additional buildings for new machinery to meet the increased demand for current, in providing three transformers, and extending the supply mains in Banbury, Woodstock, Iffley and South Park Roads, and St. Clement's and Walton Streets.

Marconi's Wireless Telegraph Co.

The annual meeting of this company was on held the 16th inst., at River Plate House, Finsbury Circus, E.C., Colonel Sir Charles Euan-Smith, K.C.B., in the chair.

In moving the adoption of the report, the Chairman said that there was not very much to call for notice in respect of the balance-sheet, which, however, differed slightly in form from that of the preceding year. They had shown at par value the shares which the company possessed in the affiliated companies, the acquirement of which had cost them very little money. After deducting the cost of the Cape Breton station, the cost of establishing the trans-Atlantic communication and the amount apportioned in respect of patent rights transferred to associated companies, they had treated the balance as reserve, which resulted in a valuation of all their holdings in associated companies acquired under agreements, at a cost only of £63,745 on the debit side of the account, they had from the share premium account deducted the debit balance of £21,850, shown in the last year's account. The profit and loss account would show them that, for the year under review, which ended September 30th, 1904, they had made a net profit of £12,681 5s. 3d., and although that result had called forth some criticism on the part of one or two of the journals connected with the cable interests, the directors did not consider it as being other than satisfactory. In 1902 they made a profit of £5,489 8s. 3d.; in 1903, of £10,607 7s. 8d., and this year, £12,681 5s. 3d. In 1902 they received a subsidy of £16,000 from the Canadian Government; and in 1903 a sum of £20,000 from the British Admiralty. Critics of their balance-sheets for those years pointed to those payments as exceptional. In the year under review they had received no similar payments, and the profit of £12,681 might, therefore, be considered as the more satisfactory, and as indicating a general expansion of the business from sales and royalties, without any payment which might be regarded as exceptional. It was not, of course, claimed that the Marconi wireless system was at present in full working order as a profit-earning concern. It was in the same process of development which a gold mine had to pass through before it could be worked up to its full producing powers. What the company had hitherto accomplished had been the laying of the basis of future operations on so sure a foundation by the contracts they had with various Governments and companies that they were in a position to which no other system, even if successful as an invention, could attain. In that connection it might be useful for those who read the criticisms that appeared in the newspapers, to reflect upon what was the actual position of affairs. It was, of course, necessary for newspapers to put before their readers all details regarding the various inventions which might enter into competition with the Marconi system. Their chances of success were dwelt upon, their merits eulogised, and he saw no objection to that. But what were the practical results? In Italy, Germany, France, and other countries they heard a great deal of the inventions for wireless telegraphy which had been patented by subjects of those countries; but in Germany the Marconi system held the field upon the German liners, while the Italian Government had not only embodied the system in the public telegraphic service, but Italian men-of-war and other vessels were equipped with their apparatus, and the French liners, ships of the American Trust, Dutch ships, and Canadian ships, all carried the Marconi apparatus. In England H.M. Post Office was now, he was happy to say, in close alliance with them, and the British Admiralty had adopted their apparatus for use throughout the entire Navy. At present the Marconi system was, so far as they knew, the only one that was generally utilised for commercial purposes, and he could safely assert that so far as long-distance work was concerned, it was the only one which had shown any practical results. With those facts in view, with the knowledge of the contracts into which they had entered with foreign Governments and with influential companies in many countries, the directors felt that, while by no means neglecting or deprecating the value of the criticisms that might be showered upon them, they could afford to await confidently the results in the near future which were likely to afford ample compensation to the shareholders for their patience, which the directors fully appreciated. The directors were aware that some of the shareholders had at times expected more detailed information as to the business. There were, however, many contracts with Governmental and other bodies which were stepping-stones to more important arrangements, and of which it was impossible to publish details, or at times even to announce their completion. Such announcements might prove prejudicial to further developments. The chairman then proceeded to review the report, and in doing so, said that the company believed themselves now to be on the brink of completing the machinery necessary for a regular trans-Atlantic commercial service, and in view of that fact it was deemed advisable to put before the shareholders an estimate of the earnings of a single pair of stations in a year. The figures had been furnished by their scientific advisers, and it was competent for anyone to form his own conclusions as to whether or not the amount of £56,000 per annum, the amount set forth in the estimate, was correct or otherwise. In that connection he would point out that the small capital involved was a most important factor, for whereas the whole issued capital of the company was only about £250,000, the cost of a single cable between England and America was probably not less than £800,000. The agreement with the Postmaster-General had already borne fruit in the notification by the Post Office that on the 1st of January last messages from the United Kingdom could be transmitted from postal telegraph offices to ships at sea by the company's shore stations. On the occasion of the recent temporary breakdown of the cable system between the Scilly Isles and the main-land, they were asked by the Post Office to carry on communication by means of their system. This they gladly consented to do, and with complete success. They awaited the result of the discussions of the proposed Berlin Conference with complete confidence, and did not anticipate that the decision of the conference would prove injurious to the material interests of the company. In conclusion, the chairman referred to the success of the meteorological service, and expressed regret at the retirement of Mr. Mooney.

Signor Marconi formally seconded the motion.

Mr. O'Brian, a shareholder, asked how it was that no mention was made in the report of the litigation with the De Forest Co., and also what was exactly meant by "Directors' fees, £3,000": what proportion of that amount did the directors actually receive?

Mr. Chambers, another shareholder, asked if the code was completed, and if so, was it in use?

In reply, the Chairman said that it was a very wise rule not to talk about legal proceedings while they were in progress. As a matter of fact, they were not in litigation with De Forests, it was the American Co. As to the directors' fees, he did not think that the matter was quite regular. The code was completed, and was in use.

A vote of thanks to the chairman concluded the proceedings.

Lanarkshire Tramways Co.—The report for the half-year ended December 31st shows receipts £18,315, and expenses £9,705, leaving £8,610. To this is added balance brought forward, £2,042, less contributions payable to local authorities £207, and interest on debentures £608, leaving £9,837. Of this amount £2,500 has been placed to reserve for depreciation, and £1,527 has been written off. The directors recommend a dividend at the rate of 5 per cent. per annum for the half-year, carrying forward £823. The capital expenditure has been increased by £14,836, which has been expended mainly on the power station, 10 new cars and permanent way (Larkhall extension and doubling track in Brandon Street). Ten new cars were put in service in July last, and a considerable increase in the traffic receipts has resulted. The track in Brandon Street has been doubled, and half the cost of taking up and slewing the original single line has been written off.

Newcastle and District Electric Lighting Co.—The report for the year ended December 31st, 1904, states that 3,259,389 units of electrical energy have been sold, as compared with 2,649,841 units in the previous year. The gross earnings for the year amount to £17,095, and after paying the interim dividend and interest on debentures and loans pertaining to revenue account, the directors recommend a dividend at the rate of 8 per cent. per annum for the half-year ended December 31st, which, together with the interim dividend paid in August last, makes 7½ per cent. for the year, carrying forward £370. The directors feel that the capital of the company is not evenly divided as between share capital and debentures, no preference shares having been created by the company. A proposal was therefore to be submitted at the annual meeting with reference to an increase in the debenture issue.

Chatham and District Light Railways Co.—The report for the half-year ended December 31st last shows receipts £16,381, and expenses £10,029, leaving £6,352. To this is added £745 brought forward, making £7,097. The directors recommend a dividend at the rate of 3 per cent. per annum on the ordinary shares for the half-year, carrying forward £1,700. The short extension line to Rochester was opened for public traffic on December 22nd last, and a substantial increase in the receipts has resulted. The agreement between the Kent Electric Power Co. and this company has fallen through. The special deposit account of £3,000 has been transferred to reserve for depreciation.

Northallerton Electric Light and Power Co.—The annual report shows a profit of £318, as compared with £263 last year, and after paying £247 2s. 2d. interest on loans and debentures, and depreciation on motor-meters and free-wired installations, there is a credit balance of £71, as compared with a credit balance of £14 the previous year. The units sold to private consumers were 10,033 in excess of last year, and the horse-power of motors connected to the company's mains is now 57, as compared with 49 in the previous year.

W. T. Henley's Telegraph Works Co.—Subject to audit the directors have decided to recommend a dividend for the year ending December 31st, 1904, on the ordinary shares of 15 per cent., less income-tax, including the interim dividend of 5 per cent. paid September 1st last. The division for the previous year was also at 15 per cent. per annum.

Crossley Bros.—The report for 1904 records a satisfactory year's trading in all departments. The profit for the 12 months amounts to £83,177, and the directors now propose to pay a further dividend for the second half of the year at the rate of 12 per cent. per annum on the ordinary shares (making 11 per cent. for the year), leaving £19,051 2s. 6d. to be carried forward.

Company Law.—The name of Mr. Felix Schuster (Governor of the Union of London and Smith's Bank) should have been in the list of members of the Committee mentioned in our last issue.

Calcutta Electric Supply Corporation, Ltd.—The number of units delivered to consumers during the four weeks ending January 27th, 1905, was 199,288, compared with 124,324 in the corresponding four weeks in the preceding year.

Stock Exchange Notices.—The Committee has ordered the undermentioned securities to be quoted in the Official List:—

Auckland Electric Tramways Co., Ltd.—Further issue of £85,100 5 per cent. first mortgage debenture stock, redeemable.

Metropolitan Railway Co.—Provisional certificates (partly paid) for £750,000 3½ per cent. convertible preference stock, 1904 (second issue).

Western Telegraph Co.—Interim dividend 3s. per share (at the rate of 6 per cent. per annum) for the quarter ended December 31st.

STOCKS AND SHARES.

Wednesday Evening.

Stock Exchange business has advanced in a remarkable manner during the current month. Investors are unloosing their purse-strings with a freedom that lifts prices in all directions. Only the mining markets are disconsolate, deserted of the public, and the erstwhile popular gambles in the Kaffir Circus fail to show the buoyant tone noticeable amongst the investment sections. Yet money has not become really cheap up to the present, although it was said that the Bank Rate must go down this week. The Stock Exchange has such a knack of discounting good and bad events, that a set-back may occur if the anticipated fall in the Bank Rate happens.

Our price-lists over leaf show more rises than they have done for many a long day. One excellent sign about the revival (if the Albert Hall will pardon the use of the word) is the public demand for such shares as Callender's, Henley's and India-Rubber. These Industrials have been overlooked for so long that their return to favour is a sure sign of public re-awakening to the merits of sound investments. Callender's are £1 better at 10⅜; Henley's 30s. up at 12⅜ on the dividend, and India-Rubbers have risen 10s. to 16. Brush issues hardened, the Second Debentures adding another 2 points, but Cromptons are ½ down at 2¼. Fresh demand for Babcock & Wilcox raised the price to 4⅜, and it is said that a 20 per cent. dividend is to be paid. Westinghouse Preference went a trifle better to 2⅝. The new 7 and 6 per cent. Preference shares of the British Aluminium Co. are quoted at 4¾ and 5 respectively, representing a rise in the old shares of 10s. on the week. Telegraph Constructions are better at 36, despite a poor report.

Shareholders in the old London and Globe Finance Corporation will have noticed with mixed feelings the cordial reception extended to the 4 per cent. Debenture stock of the Baker Street and Waterloo Railway, of which we have already given particulars. The concern proved a terrible white elephant to the Whitaker-Wright parent, but in these latter days the public tumble pell-mell over one another to acquire stock whose security is scarcely of the highest rank. A premium of 3 points is established over the issue price of 96, and the applications were so large as to necessitate a very small allotment in proportion.

Central London Ordinary and Preferred both show rises of 2 per cent., although the Deferred has not moved. City and South London recovered ¼ to 45, but Metropolitan Consolidated is steady at 96, Districts being about 42. East London has been done at 5⅜, and the company's Second "B" Debenture sticks about 38. Great Northern and City Preferred shares are 6¼; Great Northern and Piccadilly Ordinary remain at 9.

Electricity Supply descriptions are somewhat disappointing in their indifference to the generally strong tone of the markets. London Electrics are ⅛ better at 2⅜, but South Londons at 4¼ have lost a similar fraction. Metropolitans advanced to 18⅜, but fell back again to 18½, while Westminsters are ¼ better at 13½. A trio of Debentures rose a little, but Smithfields 4 per cent. Debenture stock at 81 has given way 3 points, Charing Cross Ordinary are down ¼ to 8¼, and the Preference ⅛ to 5⅝, the report being considered disappointing as regards the City undertaking. County Ordinary are ⅛ better at 9⅛. The Chelsea meetings (three being held in about half-an-hour) were only remarkable for their pacific nature. Very different to this colourless tale is the record of the Telegraph section. Most of the active stocks and shares are better, and the demand for Debentures gives no indication of slackening. Amazon Telegraph shares, which hardly ever move, are 15s. higher at 2, business having been transacted at 1⅞. Anglo-American Telegraph rose 1, the Preferred 3, and the Deferred ⅛, to 60, 107 and 13⅞. We maintain our previously-expressed opinion that the Preferred is a fair speculative investment. West India and Panama First Preference are 10s., and the Second Preference 15s., up, the prices now being 8¾ and 8½; comparing with 7⅜ and 7 a fortnight ago. West Indian prospects are the cause of the rise. The Eastern group is also good, China shares being ⅛ better at 14¼, and Eastern Ordinary 2 up at 141½. Direct United States rose ¼, and Great Northerns ½, the improvements in practically every case being due to persistent investment support. Globe Telegraph and Trust Ordinary rose ¼ to 10⅝, sympathetically with the rises in issues in which the company hold interests. Submarine certificates are two points firmer at 124½, and everything connected with the American market is touched with the infectious glamour of bullishness. The Commercial Cable Co. is about to lay a fifth line of its own across the Atlantic.

Smart falls took place in National Telephone Deferred and Preferred upon publication of the Government's agreement with the undertaking. The Deferred has given way 4 to 106, proprietors not liking the phrase "Tramway Terms" any more than the policy that it represents. The Preferred quickly got over its weakness, and is actually better at 111. United River Plate Telephones jumped ¼ to 7½, and Chili Telephones at 6½ are ½ higher. Telephone of Egypt 4½ per cent. Debenture is quoted 101 to 104.

In the Traction market business is steady, but without altering prices to any extent. The Imperial Tramways dividend, making 9 per cent. for the year, caused no change in the price, which stays about 19 to 20. London United Preference fell, on the report, to 10¼, and there is a good deal doing in Calcutta Tramway shares about 8⅞. Dublins are 13½, Belgranos 3⅝, and Anglo-Argentine Ordinary 8 7/16. British Electric Preference are ½ down. London United shares should, in our opinion, be sold.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1902.	1903.	1904.	Closing Quotations Feb. 15th.	Closing Quotations Feb. 22nd.	Business done week ended Feb. 22nd, 1905. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	99 —102	99 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	1⅞— 2⅛	1⅞— 2⅛	1⅞	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,950 Red.	100	..	..	..	.. — ..	.. — ..	..	..
788,840	Anglo-American Telegraph	Stock	60/6	61s.	2¾%	58 — 60 xd	59 — 61 xd	..	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5¼%	103 —105 xd	106 —108 xd	106½	104½
3,105,580	Do. do. do. Deferred	Stock	1/-	2s.	Nil	13⅜— 13¾	13⅜— 14	14⅛	13⅞
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	..	6½— 6¾	6⅝— 6⅝	6½	..
13,333,300$	Commercial Cable	$100	8 %	..	..	170 —190	170 —190	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	95 — 97	96 — 98	98	97
16,000	Cuba Telegraph	10	6⅔%	5 %	..	8⅞— 9⅛	8⅞— 9⅛	8⅞	..
6,000	Do. 10 % Pref.	10	..	..	..	17 — 18	17 — 18	17½	17
12,981	Direct Spanish Telegraph, Ord.	5	..	..	..	3⅜— 3⅝	3⅜— 3⅝	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	8 — 8½	8 — 8½	..	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	100 — 102	100 — 102	..	..
60,710£	Direct United States Cable	20	8½%	8 %	..	11 — 11½	11½— 11⅝	11⅝	11⅜
78,500	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,900, Red.	100	..	..	..	100 —102	100 —102	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	138 —141	140 —143	142	139½
1,955,565	Do. 5½ % Pref. Stock	100	..	..	..	88 — 90	88 — 90	89½	88½
1,584,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	106 —108	107 —109	107½	106½
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	..	13⅜— 14	13⅝— 14½	14½	13½
800,000£	Do. 4 % Deb. Stock	Stock	..	..	..	104 —106	104 —106	105½	..
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	100 —102	100 —102	100½	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	101 —103	100 —102	..	..
180,227	Globe Telegraph and Trust	10	£3 16 7*	5½%	..	10⅜— 10⅝	10⅜— 10⅝	10⅝	10⅝
180,042	Do. do. 6 % Pref.	10	..	..	..	13⅝— 14⅛	13⅝— 14⅛	14⅛	13⅞
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	15 %	..	29½— 30½	30½— 30⅞	30	..
50,600	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,500, Red.	100	..	..	..	100 —102	100 —102	..	..
17,000	Indo-European Telegraph	25	10%	10 %	..	46 — 48	46 — 48	47½	47½
72,580	Monte Video Telephone Co., Ltd., Ord.	1	3 %	3 %	..	⅛— ⅜	⅛— ⅜	..	..
1,988,338	National Telephone, Pref. Stock	100	6 %	6 %	6 %	109 —110	110⅝—111¼	111	109½
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	109 —111	105 —107	110½	104
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 13	12 — 13	12¾	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	3½%	5⅛— 5½	5⅛— 5½	5⅛	5⅛
000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	4 %	97 — 99	98 —100	18½	98½
689,598	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	..	102 —104	103 —105	104½	103½
1,000,000	Do. do. Prov. Certs., all paid	..	..	..	..	103 —104	103 —105	..	..
179,318	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6½%	..	1 1/16— 1 1/8	1 1/16— 1 1/8	..	..
50,000	Do. do. do. 6 % Cum. Pref.	1	..	..	..	1 1/16— 1 1/16	1 1/16— 1 1/16	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	98 —101	98 —101	..	..
11,889	Reuter's	8	5 %	..	..	7 — 7½	7 — 7½	7⅝	..
8,808	Submarine Cables Trust	Cert.	..	..	..	121 —124	123 —126	..	..
58,000	United River Plate Telephone	5	7 %	..	..	7 — 7½	7⅛— 7½	7⅝	7⅛
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	5 — 5½	5 — 5½	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	105 —107	106 —108	..	..
15,609	West African Telegraph, Shares	10	2 %	4 %	..	7⅛— 7⅜	7⅛— 7⅜	..	..
80,008	West Coast of America, 1 to 80,000 and 53,001 to 53,009	2½	..	..	..	1/16— 1/16	1/16— 1/16	..	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Brss. Sub. Tel.	100	..	..	..	99 —101	99 —101	..	..
267,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	..	13⅛— 14	13⅛— 14	13⅞	13⅝
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	101 —103	101 —103	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	102 —104	102 —104	..	102½
88,331	West India and Panama Telegraph	10	..	..	..	1⅛— 1⅜	1⅜— 1⅜	1⅜	1 25/32
34,568	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	8 — 8½	8⅝— 9	8⅞	9¼
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	7½ — 8	8⅜— 9	8⅝	8
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	102 —104	102 —104	104	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	9 — 9¼	4¼— 5	4¼	..
10,000	Do. do. "A" 6 % Cum. Pref.	10	..	..	..	9½— 10	4⅜— 5⅛	4⅜	..
800,000£	Do. do. 5% 1st Mort. Deb. Stock Red.	Stock	..	..	..	58 —102	98 —102	..	..
100,000	British Electric Traction	10	8 %	..	..	9¼— 9⅜	9⅜— 9⅜	9⅜	9⅛
100,000	Do. do 6 % Cum. Pref.	10	..	..	..	11 — 11⅛xd	10⅜— 11⅛xd	11⅛	11
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	120 —122	120 —122	121⅛	121
	Do. do. 4½% 2nd Deb. Stock Red.	100	..	..	..	95 — 97	97 — 99	98½	97⅞
100,000	British Insulated and Helsby Cables	5	10 %	8 %	..	5⅜— 6⅛	5⅜— 6⅛	6	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5⅛— 5⅜	6⅛— 6⅜	6⅜	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	101 —104	101 —104	101	..
50,000	¶Browett, Lindley & Co., Ord.	£1	..	..	..	7/16— 1/2	7/16— 1/2	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	..	..	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	Nil	Nil	..	1/4— 3/4	1/4— 3/4	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	..	1⅜— 1⅝	1¼— 1½	1⅜	1¼
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	93 — 96	94 — 97	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	77 — 80	79 — 82	..	..
35,000	Callender's Cable Construction shares	5	15 %	12½%	..	9½— 10	10⅛— 11	10½	9 15/16
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	7⅜— 8⅛	8⅜— 8⅝	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	105 —107	105 —107	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	4 %	4 %	..	90 — 92 xd	92 — 94 xd	93½	92½
494,098	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	..	99 —101 xd	101 —103 xd	102½	100⅛
494,998	Do. do. Def. do.	Stock	4 %	4 %	..	81 — 83 xd	81 — 83 xd	82	..
1,380,000	City and South London Railway	Stock	2½%	2½%	2⅛%	44 — 45 xd	44½— 45½xd	45½	44½
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	..	..	2¼— 2½	2¼— 2½	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	98 — 98	98 — 98	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £8 paid, 1 to 99,261	5	Nil	..	..	⅝— ¾	⅝— ¾	..	..
17,189	Do. do. "A" shares, 01—017,189	5	Nil	..	..	1 — 1⅛	1 — 1⅛	..	..
344,028£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	77 — 82	77 — 82	80	79½
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	79 — 84	79 — 84	..	..
112,100	lectric Construction 1 to 112,100	2	6 %	4 %	..	1¼— 1½	1¼— 1½	..	..
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	..	..	..	2¼— 2⅜	2¼— 2⅜	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	97 — 99	97 — 99	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	..	..	9⅛— 10	9⅛— 10	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	91 — 96	91 — 96	..	..
200,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	15 %	15 %	11 — 11¼	12⅛— 13	12 13/16	11¼
200,000	Do. do. 4½ % Pref.	5	..	..	..	5⅜— 5 7/8	5⅝— 5 7/8	5⅝	5⅜
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	111 —113	111 —113	112⅛	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	..	..	15 — 16	15½— 16½	16 3/8	16¼
800,000£	Do. do. 4 % 1st Mort. Deb.	100	..	..	..	99 —102	100 —103	..	..
87,500	†Liverpool Overhead Railway, Ord.	10	1¼%	1¾%	1½%	3⅝— 3¾	3⅝— 3¾	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	9¾ — 10¼	9¾ — 10¼	..	..
87,350	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	34 — 36	35 — 37	35⅝	..
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	101½ —103½	102 —104	..	..
640,000£	Waterloo & City Railway. Ord. Stock	100	3½%	3½%	3½%	92 — 94	92 — 94	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

(Bank rate of discount 3 per cent. (April 21st, 1904.

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).— ELECTRICITY SUPPLY COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years			Closing Quotations Feb. 15th.	Closing Quotations Feb. 22nd.	Business done week ended Feb. 22nd, 1905.	
		‡	1902.	1903.	1904.			Highest.	Lowest
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	£	8 %	10 %	..	10¼— 11	10¼— 11	..	..
20,000	Do. do. 7 % Cum. Pref. ..	£	..	..	..	10½— 10¾	10½— 10¾	..	..
250,000	Central Electric Supply 4 % Guar. Deb. Stock	100	..	..	..	105 —108	105 —108	..	..
50,000	Charing Cross and Strand Electricity Supply	£	10 %	8 %	8 %	8⅛— 8⅜	8 — 8⅜	8⅜	7⅞
70,000	Do. do. do. 4½% Cum. Pref. ..	£	..	..	..	6⅜— 6⅝	6⅛— 6⅜xd	6⅛	6⅛
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	£	..	..	..	4 13/16— 5 1/16	4 13/16— 5 1/16	5	..
40,000	Do. do. 1903	£	..	..	..	4 13/16— 5 1/16	4 13/16— 5 1/16	5 3/16	5
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	102 —104	102 —104	103½	103
44,486	*Chelsea Electricity Supply, Ord.	£	4½%	5½%	6 %	6⅞— 7⅛	6⅞— 7⅛	7	6 13/16
150,000‡	Do. do. % Deb. Stock Red.	Stock	..	..	..	108 —110	108 —110	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595 ..	£	5 %	5 %	6 %	12⅝— 13	12⅝— 13	12⅞	12⅝
40,000	Do. 6 % Cum. Pref., 1 to 40,000	£	..	..	..	13⅝— 14	13⅝— 14	13⅞	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	£	..	..	..	122 —126	123 —127	124	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	102 —104	103 —105	104⅛	103½
40,000	County of London Electric Lighting, Ord. 1—40,000	£	4 %	4 %	..	9 — 9⅛	9⅛— 9⅜	9⅛	..
20,000	Do. do. do. 6 % Pref., 40,001—60 ..	£	..	..	..	12 — 12½	12 — 12½	..	..
400,000‡	Do. do. 4½% Deb. Stock	..	..	..	..	108 —111	108 —111	..	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	102 —104	102 —104	103½	103
70,000	Edmundson's Electric Corporation, Ord. Shares	£	7 %	7 %	..	6⅛— 6⅜	6⅛— 6⅜	6 7/16	6 3/16
70,000	Do. do. 6 % Cum. Pref.	£	..	..	..	6 — 6⅛	6 — 6⅛	6 1/16	6⅛
800,000‡	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	106 —108	106 —108	..	..
21,000	Kensington and Knightsbridge Electric Ord.	£	10 %	12½	12 %	13 — 13½	13 — 13½	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	102 —104	102 —104	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	£	..	..	3 %	2⅛— 2⅜	2⅛— 2⅜	2 3/16	2⅛
49,840	Do. do. do. 6 % Pref.	£	..	..	..	5⅞— 6	5⅞— 6⅛	5 15/16	..
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	96 — 98	98 —100	99½	..
100,000	Metropolitan Electric Supply, 1 to 100,000	£	7½%	8½%	..	18⅛— 18⅜	1⅛— 18⅜	19	18⅜
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	£	..	..	..	5⅛— 5⅜	5⅜— 5⅝	5 11/16	..
220,000‡	Do. do. 4½% 1st Mort. Deb. Stock ..	..	..	..	..	110 —115	110 —115	..	..
250,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	96 — 98	96 — 98	..	..
10,852	Notting Hill Electric Lighting	£	6 %	6 %	..	14½— 15½	14½— 15½	15	..
59,000	Do. do. 4% 1st Mort. Deb.	100	..	..	..	102 —104	102 —104	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	£	14½%	14½%	14½%	13⅞— 14⅛	13⅞— 14⅛	14⅛	13 15/16
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	£	..	..	..	8⅞— 9	8⅞— 9	..	..
150,000‡	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	98 —100	98 —100	..	..
12,000	Smithfield Markets Electric Supply, Ord.	£	2½%	4 %	..	2⅞— 3⅛	2⅞— 3⅛	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	..	..	..	82 — £6 xd	79 — 83 xd	80	79½
65,000	South London Electricity Supply, Ord.	£	..	12½	8 %	4⅛— 4⅜	4⅛— 4⅜	..	..
100,000	South Metropolitan Electric Light and Power Ord.	£	..	..	..	⅞— 1	⅞— 1	..	..
50,000	(*Late Blackheath and Greenwich* 7 % Pref.	£	..	..	..	1 3/16— 1 5/16	1 3/16— 1 5/16	..	..
100,000	*Dist. E.L.Co.*) 4½% 1st Deb. Stock	100	..	..	..	107 —110	107 —110	..	..
80,000	Urban Electric Supply, Ord.	£	..	..	..	5 — 5⅛	5 — 5⅛	5⅛	5 1/16
80,000	Do. do. 5 % Cum. Pref.	£	..	..	..	5⅛— 5⅜	5⅛— 5⅜	5⅜	..
200,000	Do. do. 4½% 1st Mort. Deb. Stock Red ..	100	..	..	..	105 —107	105 —107	106⅜	..
110,000	Westminster Electric Supply, Ord.	£	12 %	13½%	14%	13 — 13⅛	1⅛— 13⅜	13 1/16	13⅛
28,141	Do. do. 5 % Cum. Pref.	£	..	..	..	6⅛— 6⅜	6⅛— 6⅜	..	..

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, February 22nd.

	CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a	Acid, Hydrochloric	per cwt.	5/-	..
a	,, Nitric	per cwt.	23/-	..
a	,, Oxalic	per cwt.	89/-	..
a	,, Sulphuric	per cwt.	5/6	..
a	Ammoniac, Sal	per cwt.	42/-	..
a	Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a	,, ,, ...	per ton	£30	..
a	Bleaching powder	per ton	£5 5	..
a	Bisulphide of Carbon	per ton	£15	..
a	Borax	per ton	£18	..
a	Benzole (90 %)	per gal.	7/-	..
a	,, (50/90 %)	per gal.	5/6	..
a	Copper Sulphate	per ton	£23	..
a	Lead, Nitrate	per ton	£25	..
a	,, White Sugar	per ton	£31	..
a	,, Peroxide	per ton	£27 10	..
a	Methylated Spirit	per gal.	2/6	..
a	Naphtha, Solvent (90% a 160° C).	per gal.	5/6	..
a	Potassium Bichromate, in casks	per lb.	3d.	..
a	Potash, Caustic (75/80%)	per ton	£19	..
a	Potassium Cyanide	per lb.	7½d.	..
a	Shellac	per cwt.	165/-	..
a	Sulphate of Magnesia	per ton	£4 10	..
a	Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a	,, Recovered	per ton	£5 10	..
a	,, Lump	per ton	£5	..
a	Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a	,, Crystals	per ton	£8	..
a	Sodium Bichromate, casks ..	per lb.	4½d.	..
a	,, Cyanide	per lb.	7d.	..
	METALS, &c.			
b	Aluminium Ingots, in ton lots ..	per ton	£180	..
b	,, Wire, in ton lots ..	per ton	£168	..
b	,, Sheet, in ton lots ..	per ton	£166	..
b	Babbitt's metal ingots	per ton	£43 to £140	..
c	Brass (rolled metal 2" to 12") basis	per lb.	7½d.	..
c	,, Tube (brazed)	per lb.	9½d.	..
c	,, ,, (solid drawn) ..	per lb.	8¾d.	..
c	,, Wire, basis	per lb.	7¾d.	..
c	Copper Tubes (brazed)	per lb.	10d.	..
c	,, ,, (solid drawn) ..	per lb.	10½d.	..
c	Copper Bars (best selected ..	per ton	£80	..

	METALS, &c. (*continued*).		Latest Price.	Fortnight's Dec. or Inc.
g	Copper Sheet	per ton	£80	..
g	,, Rod	per ton	£80	..
e	,, (Electrolytic) Bars ..	per ton	£70 10	..
e	,, Sheets ..	per ton	£87	..
e	,, ,, Rod ..	per ton	£81	..
e	,, ,, H.C. Wire	per lb.	9¾d.	..
f	Ebonite Rod	per lb.	3/3	..
f	,, Sheet	per lb.	3/-	..
m	German Silver Wire	per lb.	1/6	..
h	Gutta-percha fine	per lb.	9/-	..
h	India-rubber, Para fine	per lb.	5/3½ to 5/5	inc.
i	Iron, Charcoal Sheets	per ton	£18	..
i	,, Pig (Cleveland warrants)	per ton	48/2	5½d. inc.
i	,, Forgings, according to size	per ton	From £11	..
i	,, Scrap, heavy	per ton	47/6 to 50/-	..
i	,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g	Lead, English Ingot	per ton	£12 15	2/6 dec.
g	,, ,, Sheet	per ton	£14 2 6	..
m	Manganin Wire No. 28	per lb.	8/-	..
g	Mercury	per bot.	£7 12 6	..
d	Mica (in original cases) small ..	per lb.	6d. to 1/	..
d	,, ,, ,, medium	per lb.	2/6 to 4/-	..
d	,, ,, ,, large ..	per lb.	4/6 to 8/6	..
p	Phosphor Bronze, plain castings	per lb.	1/0½ to 1/3	..
p	,, rolled bars & rods	per lb.	1/0½ to 1/3	..
p	,, ,, strip & sheet	per lb.	1/2	..
o	Platinum	per oz.	82/6	1/- inc.
e	Silicium Bronze Wire	per lb.	10d. to 11½d.	..
i	Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i	,, ,, in bars		£15 to £40	..
g	Tin, Block	per ton	£131 10 to £132	dec.
n	,, Wire, Nos. 1 to 16	per lb.	1/7½	..
p	White Anti-friction Metals— "White Ant" brand ..	per ton	£43 to £65	..
f	Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
f	,, 6 lea. Flax	per lb.	5½d.	..
f	,, 3 ply 10 lbs. Russian ..	per lb.	4 7/8d.	..
f	,, 10 lbs. Russian, single ..	per lb.	4½d.	..
j	,, 180 lbs. Jute rove ..	per ton	£11	..
k	Zinc, Sh's (Vieille Montagne bnd.)	per ton	£22 5	£1 2 6 dec.

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co., *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakespeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

Electric Coal-Cutting Machinery.—In connection with a recent meeting of the Mining Institute of Scotland held in Glasgow, a demonstration was given of the working of electrical coal-cutting machinery. The demonstration took place in the works of Messrs. Mavor & Coulson, Ltd., electrical engineers, Mile End, Glasgow. The machine which is known as the "Pickquick," and represents the latest development in the firm's automatic coal-cutters, has already been fully described in the ELECTRICAL REVIEW. One of the advantages which the makers claim for it, is less noise in working, besides making work more pleasant for the miner. The machine can be driven by direct-current electric motors, three-phase motors, or compressed air motors, and the manufacturers claim great things for it in regard to cutting capacity, durability, and low power consumption.

The Hitchon Low-Tension Ignition Device.—Still another low-tension ignition device for use on petrol motor-cars on the lines of those recently illustrated in the REVIEW has just come under our notice. This is known as the "Firefly," and has been introduced by the Hitchon-Gear and Automobile Co., Ltd., of Accrington. The device which is practically the same size as an ordinary sparking plug, is almost identical with the Caron arrangement, of which we gave a description in our issue of the 10th inst.

Imports of Foreign Electrical Machinery.—The returns just issued show that the value of the foreign electrical machinery imported into this country during January last amounted to £46,928, which compares with £37,381 in the preceding month and £46,937 in January, 1904.

THE OLYMPIA AUTOMOBILE EXHIBITION.

(*Concluded from page 292.*)

Another interesting exhibit of electrical vehicles was that of the Electromobile Co., Ltd., of 7, Curzon Street, W., who showed their latest type of chassis, several carriages, and a novelty in the shape of an electric ambulance van. The company's original chassis has already been described in these columns; improvements have been introduced by slightly lengthening the wheel base and improving the spring suspension.

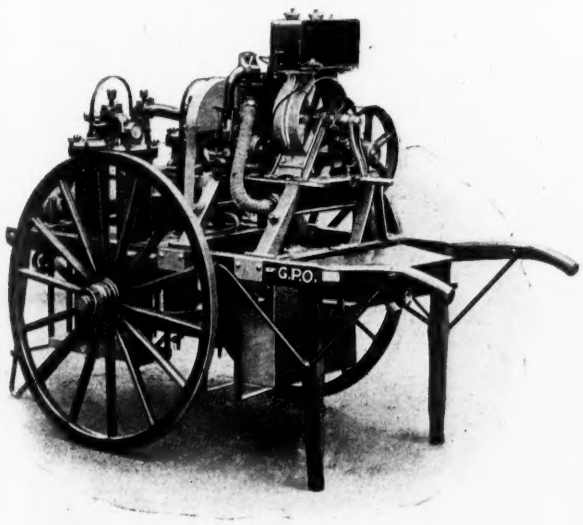
The latest type of chassis is fitted with a safety device, which renders it impossible for the running plug to be inserted in its socket, except when the controller is on the zero position; the socket has also been placed in a conspicuous position.

The ambulance van is an up-to-date vehicle mounted on one of the company's ordinary chassis. It contains two full-length stretchers, which slide into one side of the van, allowing ample space for an attendant to move about. The carriage is provided with electric lighting and heating, also telephonic communication between the driver and attendant; it is intended for town use, and will cover a distance of 25 miles on a single charge of the battery.

The Kriéger Electric Carriage Syndicate, Ltd., exhibited one of their vehicles, in which each of the front wheels is driven separately by a motor, as described in our reference to the Crystal Palace show (Electrical Review, February 3rd).

Electric Ambulance Van.

The Simms Manufacturing Co., Ltd., of Kilburn, N.W., were prominent with fine examples of the petrol car: their well-known "Simms-Bosch" magneto-ignition which was conspicuous on many motors, and a 100-h.p. four-cylinder engine, specially designed for marine or railway work, and in which the accessibility of the valve-gear and crank chamber were ruling features, merit special mention. Our illustration shows a convenient application of the 3½-h.p. Simms motor for driving a portable air-pump, as supplied to the G.P.O. and employed for forcing dry air through the telephone ducts.



Simms Portable Air-pump Set.

In the annexe, the well-known electrical firm of Messrs. Johnson & Phillips were exhibiting the Newman variable-speed gear and adjustable universal joints and couplings. The Newman gear contains several novel features. It consists of a small variable-throw eccentric fixed on the end of the constant-speed shaft; the eccentric, by means of connecting links, oscillates in turn four small clutches, fitted with exterior gear teeth, which are driven forward only, and which gear with a centre pinion fitted on to the end of the variable-speed shaft, imparting to the latter a continuous rotary motion.

Referring to the key diagram, the centre of the eccentric is shown at A. The centre lines of the connecting links are represented by the lines B_1, B_2, B_3, B_4, which are connected at their outer ends to studs C_1, C_2, C_3, C_4, the studs being fixed in the clutches D_1, D_2, D_3, D_4. The clutches are of the roller type, and drive only in one direction, they turn on pins E_1, E_2, E_3, E_4, fixed into the casing surrounding the gearing. The gear teeth surrounding the clutches are shown by F_1, F_2, F_3, F_4, and the common pinion in the centre by G; the latter, it will be noted, is always in gear.

It will be seen that the greater the throw of the eccentric, the greater will be the distance through which the clutches oscillate; if the throw is nil, the clutches will be at rest. As each clutch moves forward it drives its gear ring through a certain distance, and then releases; the next clutch, however, has taken up the driving before the latter operation occurs, and consequently the motion imparted to the variable-speed shaft is continuous.

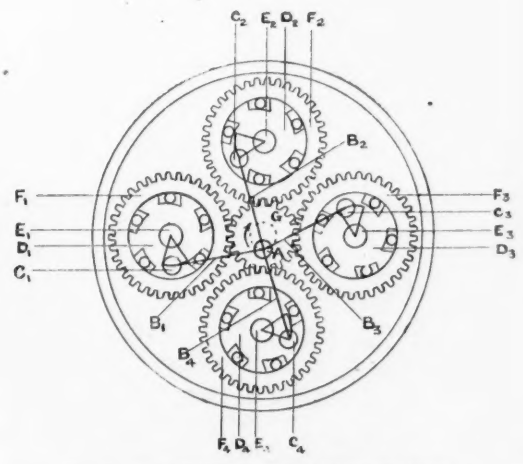
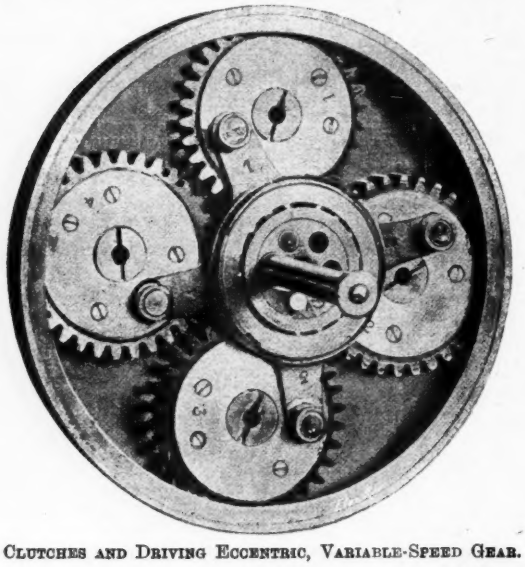


Diagram of Newman Variable-speed Gear.

In the case of a Daimler car fitted with the gear, the variable-speed shaft can be varied from zero (stop) up to full engine speed, *i.e.*, 750 r.p.m., and actual tests are said to give an efficiency of over 90 per cent. It goes without saying that the gear will find many uses other than on the

motor-car; our illustrations show its application to a motor-car gear-box and as a variable speed countershaft.

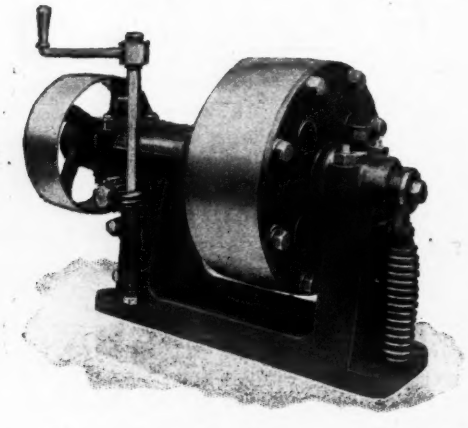
Messrs. Willans & Robinson, Ltd., exhibited samples of their new vanadium steel, a product of their Queen's Ferry



Clutches and Driving Eccentric, Variable-Speed Gear.

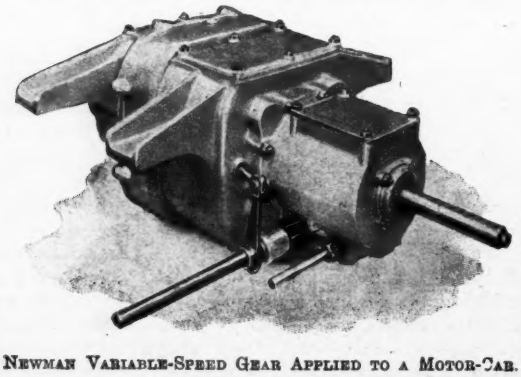
Works, possessing unique properties which make it exceptionally suitable for motor-car construction.

Messrs. Peto & Radford, Ltd., of 55, Hatton Garden, E.C., were, as usual, well represented in the matter of accessories;



Newman Variable-Speed Gear Applied to a Counter-Shaft.

accumulators, electric ignition and lighting devices, magnetos and dynamos, instruments, rectifiers, &c., finding a place on their stall. This firm also had on view Walker's (patent)

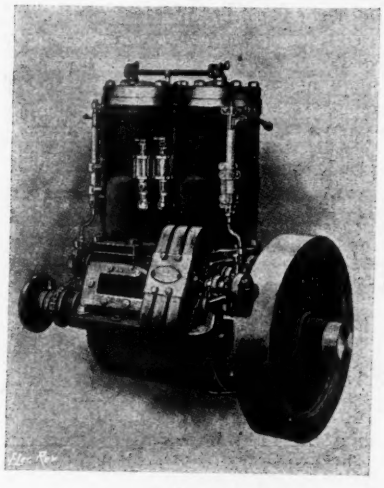


Newman Variable-Speed Gear Applied to a Motor-Car.

dynamometer for measuring the B.H.P. of electric and petrol motors; it is a simple device consisting of a couple of vanes, which are clamped on to the spindle of the motor to be measured. From the speed, position and size of the vanes, the horse-power can be immediately obtained from the calibrated results which are supplied with the dynamometer.

The "Fire Fly" ignition plug, a patented low tension device, shown by the Hitchon Gear and Automobile Co., Ltd., of Accrington, appears to be almost identical with the "Caron" device shown recently at the Crystal Palace and described in the Electrical Review of February 10th. The plugs are standard size, and although intended for use with a magneto, will work satisfactorily on three or four cells.

Among other exhibitors we noticed the Langdon-Davies Motor Co., Ltd., of 101, Southwark Street, S.E., who had a selection of the "Soames" change speed gears on view; and the Brotherhood-Crocker Motors, Ltd., with whom is associated the old-established firm of Peter Brotherhood, so well known in connection with high-speed engine work.



Lozier Launch Motor with Magneto Ignition Gear.

The cars built by this firm are fitted with an ingenious high-tension ignition device, in which the satisfactory working of the ignition circuits is always visible to the driver, and the advancing or retarding of the sparking is automatically controlled by means of a small centrifugal governor.

Although the show primarily catered for the individual blessed with a long purse, yet cars of cheaper construction were not entirely absent, and the palm for novelty in this direction must be awarded to the exhibitors and makers of the Orient motor buckboard, a light vehicle, which, as its name implies, hails from America—in fact, from the factories of the well-known Waltham Manufacturing Co., of watch fame.

We gather that the show was a great commercial success, one well-known journal giving, on good authority, an estimate that over two million pounds' worth of orders were placed while the exhibition was in progress.

AN IDEAL SWITCHBOARD BASE.

By LEONARD J. PUMPHREY.

Every manufacturer of switchboards and distributing panels knows of the great difficulties invariably met with, in finding a satisfactory material to carry the several fittings and instruments that are necessary. The suitability of any material depends partly upon its mechanical and partly upon its physical properties.

From a mechanical point of view the material should be strong and tenacious, and should readily lend itself to drilling and machining. The necessary physical properties are more important; in addition to being fire-proof, an ideal material should be acid-proof and completely non-hygroscopic. Electrically it should have a high insulation under all conditions, and should be proof against "piercing" under electrostatic strain.

Slate and marble are the two materials that have been and are still most extensively used for this class of work,

but unfortunately both of these have many serious defects, which have only been to some extent overcome. They are both natural products and the quality varies enormously. The insulation resistance of a slate slab of given size, varies from 300 megohms in an exceptionally good, prepared and selected sample, down to ·01 ohm in another sample of equally prepossessing appearance, but which has a concealed metallic vein in its structure. Usually, a fault of this kind is not revealed until the slate reaches the test-room, and the author has on several occasions been surprised and disappointed to find that he could light a couple of glow lamps through a slate upon which £20 worth of labour had been

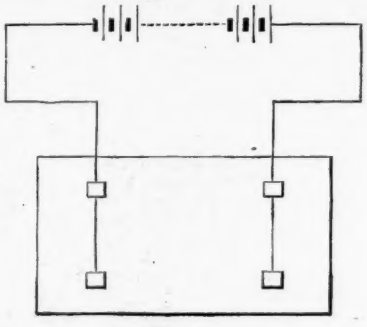


Fig. 1.

spent. Why should it not be possible to manufacture a suitable material with a uniform composition and properties that could be relied on?

Glass and other vitreous substances can be moulded into suitable slabs with perfect insulating properties, but these cannot be drilled or machined in any way, and this is, of course, a fatal drawback.

What we are looking for is a material that has the insulating and non-hygroscopic qualities of glass, that can be drilled like slate, that can be moulded in any shape, and that is entirely acid-proof. The latter is of great importance where the switchgear is for use in factories where the air is charged with acid fumes.

Such a material has at last been found, and has already given the utmost satisfaction for electrical purposes on the Continent. "Opaline," as it is called, is as yet little known in England, and the results of some experimental work in connection with its electrical properties may be of general interest. For the purposes of the experiment, rectangular slabs of slate, marble and opaline were used, and in each case tests were made with the view to the comparative determination of the following :—

1. Resistance in megohms.
2. Surface insulation.
3. Capacity for withstanding electrostatic strain.

It will be interesting to bear in mind that the slate and marble samples were obtained from well-known suppliers of these materials, who were advised of the nature of the experiments that would be made. The samples were, therefore, regarded as the very best of their kind, free from metallic veins, and without structural defects.

Experiment 1.—In this experiment the readings were taken after a period of electrification of 15 minutes, and the results are shown in Table I. Contact was made with the aid of mercury baths, and in the case of slate and marble two samples of each were tested.

TABLE I.

Substance.	Dimensions of sample, cm.	Thickness, cm.	Pressure, volts.	Resistance, megohms.
Marble ...	10 × 15	2·6	288	13,500
Marble ...	10 × 15	2·6	288	9,500
Slate ...	10 × 15	2·5	288	340
Slate ...	10 × 15	2·5	288	280
Opaline ...	10 × 15	2·6	570	15,000,000

The results of this experiment are so definite, and the figures speak so plainly for themselves, that any comment is unnecessary.

Experiment 2. Surface Insulation.—The object of this experiment was to ascertain the amount of surface leakage across the samples under different conditions. Switchboards are often installed in factories and engine rooms where the air is charged with moisture, and where vapour is continually condensing on any cool surface, and the experiment therefore was carried out as follows :—

Each sample was suspended vertically by carefully insulated wires. Connections were made as shown in fig. 1.

Insulation tests were made upon a sample of each material on different days, and it will be seen that the values for slate and marble vary with the state of the atmosphere owing to the hygroscopic qualities of these substances. Every sample was then subjected to a jet of steam ; the lowest insulation given under this condition was noted, and the steam was cut off. Readings were then taken at intervals, as the sample gradually dried in the open air. These results are shown in Table II. :—

TABLE II.—Surface Insulation in Megohms.

Time.	Slate.	Marble.	Opaline.
Dry	1·7	21 000	15,000,000
	150	23,000	15,000,000
	15	23,000	15,000,000
Minimum ...	·044	·25	2·3
1 minute ...	·047	·37	4
2 minutes ...	·048	·50	7·8
3 „ ...	·050	·88	12
4 „ ...	·051	3	62
5 „ ...	·052	5·3	82
10 „ ...	057	27	185,000
15 „ ...	070	46	741,000
20 „ ...	080	64	741,000
30 „ ...	15	110	741,000
1 hour	18	270	741,000

Experiment 3.—Capacity for withstanding electrostatic strain.—These tests were carried out upon three square plates of equal surface, one of slate, one of marble, and one of opaline. The thicknesses were as follows :—Slate, 1 cm. ; marble, 1 04 ; opaline, ·44 cm.

Electrical contact was made with the aid of two tinfoil disks, 260 cm.^{2} in area, pressed centrally against the top and bottom surfaces of the plates.

Step-up transformers were used for gradually increasing the applied voltage.

At 7,000 volts the slate becomes to all intents and purposes a conductor, the current flowing round its surface and scorching the material. The experiment thus came to an abrupt conclusion and a proper electrostatic breakdown test could not be made.

The marble plate broke down under an alternating pressure of 20,000 volts.

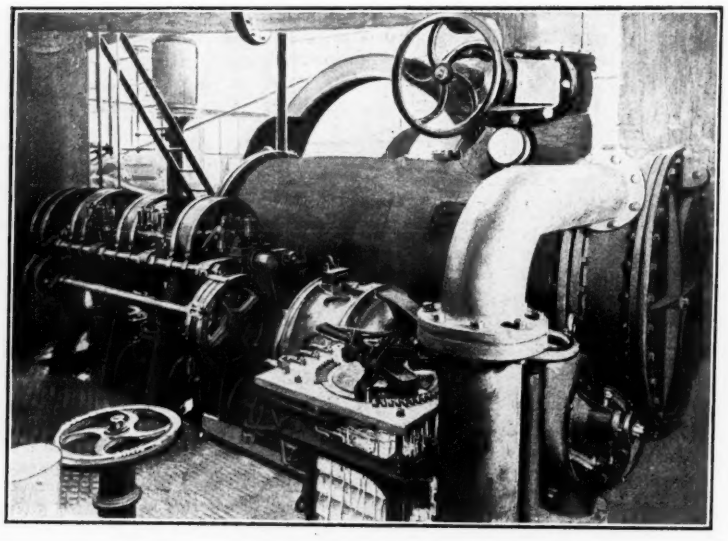
The opaline sample was next tested in the same way. When the pressure reached 40,000 volts an arc was set up between the two tinfoil disks, not through but round the edge of the plate. To prevent this the size of the disks was considerably reduced and the voltage was again raised. Finally, at 45,000 volts the material gave way under the strain and an arc leapt across through the fissure.

Conclusion.—In view of the increased demand for high tension switchgear of every description, the above results are very instructive. The need for a material to replace slate and marble, is being felt every day more keenly by electrical manufacturers. The author knows of several large firms, whose faith in slate is so far diminished that they make a standard practice of insulating every piece with micanite washers and bushes, and who invariably mount opposite poles of a D.P. switch on separate panels, insulated both from the iron framework, and from each other. The cost of production is thus considerably increased, and a material such as opaline should present many attractions to manufacturers who have had these troubles. A great advantage attaching to the use of slate is that it is easily drilled, but unfortunately the drill always brings off a flake at the under surface. Sometimes these flakes are small, sometimes large, but in any case they effectually prevent any possibility of marking out a slate on the back, and drilling it from the back.

In the above manufactured material however, the structure is uniform, and not built of strata or layers, with the result that the drill passes right through, leaving a clean cut hole both at the top and the bottom.

SURFACE CONDENSING PLANT DRIVEN BY FYNN REPULSION INDUCTION MOTOR.

In drawing up the designs for the recent extensions at the Burton-upon-Trent Corporation electricity station, it was thought preferable to drive the condensing plant for the new 500-kw. generating set off the alternating current side of the station, instead of the direct current traction side. The Fynn repulsion induction motor, the patents of which are controlled by Messrs. Witting, Eborall & Co., for Great Britain and the Colonies, was selected for this purpose, owing to the fact that when starting with a torque equal to that of full load, the starting current can be kept down to from $\frac{3}{4}$ to full load current. The accompanying illustration shows the general arrangement of the plant.



Condensing Plant Driven by Fynn Single-phase Motor.

The condensing plant was manufactured by Messrs. Cole, Marchent & Morley, of Bradford, the motor being supplied through this firm as well. It consists of an Edwards three-throw air pump and circulating pump by Messrs. Gwynne, the former being driven through gearing by means of a raw hide pinion on the shaft of the motor at a speed of 135 r.p.m., and the latter coupled direct to the motor and running at a speed of 1,440 r.p.m. The air pump valves are of the Kinghorn type. The lubrication of all parts is arranged for continuous running. The plant is specified to deal with 13,500 lb. of steam, with no superheat, and to give a vacuum at the condenser of 27 in., with circulating water at a temperature of not more than 60° F. The plant under test has been found to fully meet these requirements; the whole set is a compact arrangement, and has dealt with as much as 650 kw. The floor space taken up by the entire set is 14 ft. 9 in. × 7 ft. 9 in., and the condenser stands 4 ft. 9 in. high above floor level.

The large cylinder seen on the extreme left hand of the illustration is a grease separator by Messrs. Templer & Rance, dealing with the exhaust steam before it enters the condenser. The grease and water separated out are automatically discharged, whether the plant is running condensing or to atmosphere, by a Bundy trap.

The motor is of 14 b.h.p., with an overload capacity of about 40 per cent. The stator of the motor is built in the same way as the stator of an ordinary three-phase motor, while the rotor is generally similar to the armature of a rotary converter. It has two interconnected windings, the free ends of one being connected to slip-rings, while the ends of the coils of the other are connected up to a commutator. The operation of starting the motor is carried out as follows:—

After closing the main switch, putting the current on the stator windings, the starting switch is put on the first notch of the resistance in circuit with the brushes on the commutator side of the machine. The motor driving the condensing plant reaches a speed on the first notch of 1,060 revolutions in 5 seconds, which is a performance equal to that of any direct-current motor. There are 13 resistance notches, the speed rising to full as the switch moves over these. The slip-rings are then short-circuited by pushing in a projecting knob at the spur-wheel end of the motor-shaft. The starting switch is then moved back to the first position, and the whole of the brushes bearing on the slip-rings are raised by means of a small lever handle simultaneously. The whole operation of starting the motor and carrying out the above operations can be done in 1 to 1½ minutes. The commutation is absolutely sparkless under all conditions. The starting current is just about full load current, this being 82 amperes.* The efficiency guaranteed was 83 per cent., but, owing to a special request for a fairly high power factor, the latter was improved to 80 per cent. with a very slight reduction in the efficiency. It will also be noted from the accompanying curves that the efficiency and power factor are almost constant from 9 to 20 h.p.

This particular motor is not arranged for reversing, as this is not necessary. If it is undesirable to shift the brushes to reverse the motor, as is generally the case, a second winding is provided on the stator in quadrature with the first winding, the two being in series, and when it is desired to change the direction of rotation, all that is necessary is to change over one of the windings. It will be seen, therefore, that both windings are always operative.

In the larger sizes of Fynn motor, from 50 h.p. upwards, which also include traction motors, the Fynn method of self-excitation is provided. This is a very important feature, and has the great advantage, we are informed, of enabling the motor to work at all loads with a power factor of 100 per cent., the efficiency only being affected to a trifling extent.

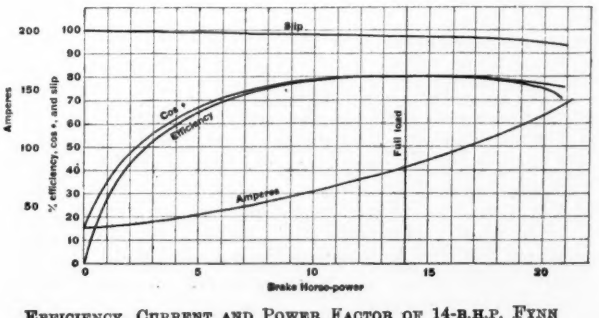
The actual power consumption, when the condensing plant was dealing with approximately 13,500 lb. of steam per hour, which is the guaranteed performance, was 12·9 kw., with a power factor of 80 per cent. Allowing for the efficiency of the motor, this gives a b.h.p. of 13·8 for driving the whole set. The total length of the circulating pipe, which draws from and delivers to the River Trent, is 308 ft., and the maximum height above normal river level is 17 ft.

This is the first application of a motor of this description driving a condensing plant, and is the second Fynn motor in operation in this country, the first being a 7-h.p. machine. In noting the performance of the motor from the curves, &c., it should be understood that the frequency at Burton is 75, which is a comparatively high figure.

We are indebted to Mr. P. J. Pringle, borough electrical engineer, Burton-upon-Trent, for the foregoing particulars and the photograph of the condensing plant.

A LONDON ELECTRICAL MOTOR-CAR GARAGE.

The problem of constructing a cheap and economical storage battery for electric car-driving has still to be solved; but, in spite of the deficiencies of those at present in use, the operation of a successful hiring-out system has been maintained by the City and Suburban Electric Carriage Co., Ltd., and the Electric Landaulet Co., Ltd., both of York Street, Westminster, and Upper Manor Street, King's Road, Chelsea, for the past three years. The scope for business in this direction, however, can only be sought amongst those possessing much above the average income, as the tariff given below will show.

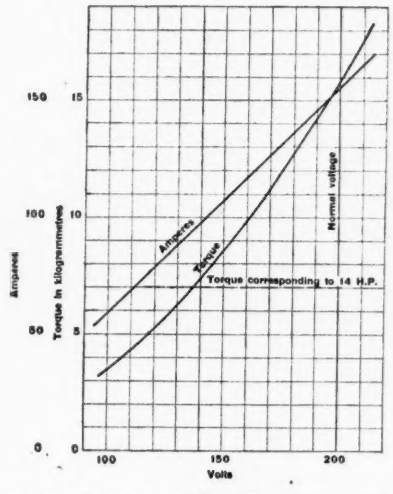


Efficiency, Current and Power Factor of 14-b.h.p. Fynn Single-phase Motor.

We are enabled to give the following particulars concerning the well-equipped garage at Chelsea:—

* On lower frequencies it becomes easier to reduce the starting current, and this can be kept down to about $\frac{3}{4}$ of full load current with full load torque.

The building was erected about three years ago, and has accommodation for over 100 cars. Two carriage-ways are provided, with 25 pits arranged along each side, making four rows, totalling 100 pits in all. Each pit is provided with its own charging panel, and to each is also allotted the licensed number of a car. The floor is wholly paved with cement, and small tracks along each of the drives are provided. A bay is built out along the left side, which contains a battery room and a small dynamo room. In the former, apparatus for "burning up" the plates is installed, oxygen and coal gas being used for this purpose. The cells are also here made up, washed, and generally overhauled, and charging panels are provided for primarily charging a newly made up set of cells, the rate being at about 10 amperes for 45 hours. The supply of electrical energy is taken from the Chelsea Electricity Supply Co at a pressure of 400 volts; the batteries are charged at about 115 volts. The transforming plant installed consists of two Lahmeyer shunt-wound



Torque and Current of Fynn Single-Phase Motor
(see page 330).

motor generator sets, each of 60 KW. capacity, generating 600 amperes at 115—125 volts, at 550 r.p.m. These are arranged for running in parallel, and by this means provision is made that would enable 120 to 130 car batteries to be charged at one time. The switchboard is of the Lahmeyer make also, fitted with no-load and overload release for controlling the low tension circuit. Motor starters of the usual type are provided for the motor circuits. From the bus-bars three mains are taken, one to each carriage-way and one to the battery room.

The charging panels used are Child's patent, and each is fitted with an ammeter and variable resistances; the switches fitted on these are mostly of the double-pole type. Repairs to the cars are executed at this garage, and recently the remodelling of some of the older type has been commenced. For carrying out repairs, two small motor-driven lathes and two drilling machines are provided, and also a small trimming shop for cushion and leather repairs, &c. All new cars are, however, built by the City and Suburban Electric Carriage Co., Ltd., at their works at Clapham.

Each of the cars is fitted with two 2-H.P. motors, both series wound, four-pole, driving the rear axle by single-reduction inside spur gearing. The majority of these motors are of the Columbia make; a few cars, however, are fitted with Riker motors. The car controllers adopted are Columbia, with three speeds, the first being with the batteries in parallel and the motors in series, giving a speed of about 3 m.p.h.; the second, all in series, allowing a speed of about 6 m.p.h.; and, in the third, the motors are connected up in parallel and the batteries in series, resulting in a speed of from 12 to 14 m.p.h. being attained. A few Child vertical controllers, with four to six speeds, are used. The Electric Landaulet Co. is about to fit new controllers to some of the cars, having seven speed adjustments, magnetic overload release and interlocking with the foot-brake. E.P.S. batteries are solely used, there being two of equal size to each car. They are of the C type, containing 44 cells altogether, arranged in two halves to permit of parallel working on the first controller position, and have a capacity of 120 ampere-hours, the average run on one charge working out at about 35 miles. The weight of each half is about 6 cwt., and for the purpose of drawing these out of the carriages, trollies are provided with suitable screw elevating and withdrawing gear. The average weight of each car in running order is from 30 to 35 cwt., three-quarters of which is available for adhesion. American-made Turner solid tires are found to be the most economical as regards wear and tear. Almost all makes of pneumatic tires have been tried, but so far have not proved satisfactory, owing to the great weight upon them. The braking apparatus consists of two sets of band brakes, one on the armature spindle, operated by hand, while the other, actuated by a foot lever, operates a powerful brake on the external surfaces of both the spur gear-wheels. A further emergency brake is available when required by using the electric reverse, which is operated by a foot-press placed in the foot-board.

The Electric Landaulet Co. have control of the hiring department of the business, and the charges at this time of year vary from 10s. per hour to 50s. per day, and from £15 per week to £330 for six months. For the summer months the prices are increased. These charges include cost of repairs, energy, washing and stabling, and drivers.

INSTITUTION OF ELECTRICAL ENGINEERS.

SOME POINTS ON THE SELECTION OF ELECTRIC CABLES.

By Ll. B. Atkinson, M.I.E.E., and C. J. Beaver, A.M.I.E.E.

(*Abstract of Paper read at Manchester, January 31st, 1905.*)

A study of the proceedings of the Institution of Electrical Engineers reveals the fact that of all the important subjects relating to the practice of electrical engineering, few have been dealt with to such a small extent as the subject of cables.

The authors of the present paper desire to take into consideration the existing types of cable, to consider the purposes to which they are adapted, and to deal with the qualities to be sought for in each type, to ensure that it may be the best of its kind.

The specification of any standard conductor should state the effective sectional area of the whole conductor, *i.e.*, the area of a solid wire having the same conductivity, and the number of wires in the strand, or alternatively, as is common in the case of small conductors, the gauge number, or diameter in mils of the wire, and the number of wires in the strand.

It should further define the minimum conductivity allowable. In the case of tinned wires, it should also state the percentage permissible departure from the standard of conductivity produced by the tinning.

Every engineer knows the enormous difference in conductivity between pure copper and copper containing small percentages of impurity, but in few cases, especially with the smaller conductors bought commercially, is this tested, and there are copper conductors in the market of not more than 80 per cent. (Matthiessen's standard) conductivity, and these are accepted and used for house wiring and other purposes without discovery. It cannot be claimed that such wire is bought by the manufacturer as high conductivity copper, for there is no difficulty in obtaining electrolytic copper of from 99 per cent. to 102 per cent. conductivity.

Cases have been known in practice, where imperfect conditions in the tinning process have resulted in a variation of as much as 12 per cent. in the conductivity of 20 S.W.G. wire.

Rubber insulated cables were the first cables used, and their use to-day is still very large for all purposes where high insulation and easy fixing and manipulation are primary considerations. Speaking generally, there is hardly any article of general commerce in which the buyer places himself so largely in the hands of the seller, as he does in the matter of india-rubber; and although large buyers often have facilities for the analysis of goods, there are difficulties in the analysis of india-rubber articles which are hardly paralleled in other general analytical work.

Conductors.—In rubber cables the copper conductors should always be tinned. It is a matter of common knowledge to those who are at all familiar with rubber goods, that oxidation is the form of deterioration to which rubber is most liable; and to a greater extent with pure than with vulcanised rubber. Now the chief office of the pure rubber layer in a vulcanised rubber cable is to prevent the sulphur in the compound rubber from attacking the conductor. It is a chemical fact that copper is a powerful carrier of oxygen, and that it will readily part with its oxygen to a substance which has a great affinity for it.

Thus we have (for certain electrical reasons) in close proximity in a rubber cable two substances, rubber and copper, which for chemical reasons should be kept apart. The coating of tin on the wire acts as the necessary separating medium, and it is obvious that its efficient application is of the greatest importance.

Until recently, specifications hardly referred to this matter at all. There is now a marked tendency to ensure reasonable efficiency and uniformity, by specifying a definite test of the tin coating. The standard test, which is known as Glover's Test, is now being used by the largest makers of tinned wire in this country and abroad; it was devised by one of us in 1897, and has been in daily use for the past seven years. Appendix I. describes the test in detail.

Pure Rubber.—This should consist of absolutely pure rubber, without admixture of any kind. Pure hard fine Para rubber sheet is chiefly prepared by what is known as the "spreading method," in which the requisite mechanical and other properties are attained by "ageing" (hanging in dark rooms at a certain temperature) for several months. With raw rubber in the neighbourhood of 5s. 3d. per lb., the cost to the cable maker will be about 8s. 6d. per lb., though at the present time rubber strip, purporting to be pure Para, is being offered at 5s. 9d. per lb. There is, therefore, little occasion for surprise to find that in foreign cables, and in cables made by firms with little or no reputation to support, the pure rubber, as above described, is replaced by a lower grade rubber, in which the requisite elasticity and mechanical properties are obtained by vulcanising by what is known as the "cold cure" method. This consists of treating the surface with chloride of sulphur in carbon bisulphide. Apart from the fact that this rubber contains sulphur, contrary to the essentials of its functions in the cable, it nearly always contains traces of hydrochloric acid as an after result of the chemical treatment. The danger of using such rubber hardly needs emphasis, but the temptation to the small maker lies in the fact that

it can be produced at something like 40 per cent. less cost than pure Para strip, made by the best method.

In some cases of cheap cables the pure rubber may be found to contain a proportion of "rubber substitute," which usually consists of oxidised or vulcanised oil, sometimes with an addition of wax. Such adulteration is not only fraudulent, but almost as harmful as the low grade chemically treated rubber referred to above

Where no attempt is made to adulterate, it is sometimes found that makers attempt to imitate the hard non-adhesive surface of correctly "aged" strip, by coating with a film of soapy composition. Wires coated with such rubber will blacken before vulcanising if traces of free alkali are present

Even in pure rubber strip, made solely from fine Para rubber, appreciable differences in the tendency to oxidise may be noticed.

The diagram shown in fig. 1 illustrates the rate of oxidation of various makes of pure rubber strip. The curves show the results of ageing tests, which were carried out by exposing weighed quantities of the finely divided pure rubber to the atmosphere continuously at a temperature of 210° F.; precautions were taken to expel all traces of residual solvent and surface moisture before the actual experiments were commenced.

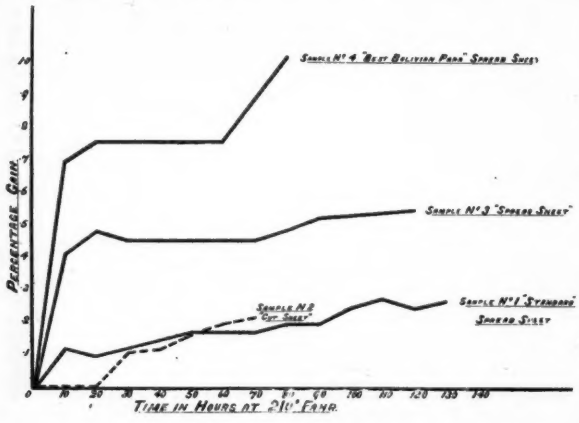

Sample No. 4. "Best Quality Para" Spoon Sheet
Sample No. 3 "Spoon Sheet"
Sample No. 2 "Cut Sheet"
Sample No. 1 "Standard" Spoon Sheet
Percentage Gain
Time in Hours at 210° Fahr.

FIG. 1.—RATE OF OXIDATION OF VARIOUS PURE SHEET RUBBERS.

It will be seen that sample No. 4 oxidised most rapidly, and after 80 hours' exposure the finely divided particles were sufficiently oxidised to form a magma.

The same thing occurred with sample No. 2 at 70 hours, while samples 1 and 3 remained unaltered at 120 and 130 hours respectively.

It was found that the proportion of rubber resins in the various samples bore a well-defined ratio to the rate of oxidation observed.

Compound or Vulcanising Rubbers.—These are generally applied in two layers, that next the pure rubber being usually drab in colour and the outer one, grey. They should have for their basis hard fine Para rubber, and should be vulcanised with a minimum proportion of pure sulphur, and mixed with mineral matter only to the extent required for the particular grade of cable which it is intended to produce.

The addition of rubber substitute, referred to under "pure rubber," should never be allowed; and the expression, "containing no organic matter other than rubber," is in some specifications intended to prohibit such materials.

In few cases are analyses made to check this important matter; even when the specification is framed to bar substitutes, large contracts are frequently placed without reference to anything of the kind, and the first-class firm has to be passed and orders given to, possibly, a foreign competitor, who does not scruple to put in his "mixings," 5 per cent., 10 per cent, or even more of a material costing anything from 4d. to 1s. per lb., in place of the hard fine Para costing from 6s. to 7s. 6d. per lb., according to the state of the market.

Such substitutes are invariably prejudicial to the life of rubber cables or any other rubber goods. They increase the liability to oxidation, because they only form mechanical mixtures, and neither combine chemically nor cohere physically; in fact, they sub-divide the particles of rubber when ground up with it, and this means imperfect results as regards durability, from mechanical and from electrical points of view.

The Admiralty moist heat test of 320° F. for four hours was designed to indicate roughly the presence of this class of adulterant, the substitute becoming partially saponified by the steam. Though only a rough test, it has answered its purpose fairly well.

Specifications frequently state the permissible percentage of mineral loading matter, or conversely the minimum proportion of Para rubber; but it will be readily seen that, in spite of specifications, the due performance of them is difficult of verification.

Consider, as an example, a specification issued not long ago for high and low tension cables, involving some thousands of pounds; and note, notwithstanding its apparent exactitude, the loopholes that existed for variation therefrom. The specification, as regards materials, ran as follows:—

Low-tension Cables.—"Conductors to be of high conductivity copper, well tinned. The insulation to consist of pure and vulcanised rubber, the latter to contain not less than (X) per cent. pure Para rubber, and the insulation to be not less than 1,250 megohms per mile."

The specification for extra-high-tension cables was worded in a similar manner, with the difference that the insulation resistance was not specified.

The contract for these cables was sent abroad, British prices being far higher than than those of foreign competitors. Analysis of samples of the dielectric supplied under the contract showed distinctly the reason of the discrepancies in the tender.

The general analytical results were as follows:—

Pure Rubbers.—These contained "Rubber Substitutes," and the proportion of them varied from 13 per cent. in the best, to 40 per cent in the worst sample. There were also indications that even the pure rubber which was present, was not fine Para, which those who drafted the specification no doubt wanted. One sample of so-called pure rubber contained over 1 per cent. of sulphur.

Vulcanised Compound Rubbers.—These contained rubber substitutes varying in quantity from 5 per cent in the best, to 15 per cent. in the worst, and although the results showed that the makers had kept wtihin 5 per cent. of the letter of the specification as regards the proportion of rubber to be used, there were signs that a rubber inferior to fine Para had been used, though, no doubt, the expression "Pure Para" in the specification was intended to mean "Fine Para," and not a rubber at little more than half the price (in the raw state).

Insulation Resistance. From the analytical results, it was plain to the authors that the specified insulation resistance could not have been obtained on some of the larger sizes of cable. It was ultimately found that difficulties in this direction had been evaded by the makers of these cables by taking the galvanometer readings after three minutes' electrification, instead of after one minute, which, in the absence of anything stated to the contrary, is the accepted standard, and the difference in test at these two intervals would correspond with an approximate difference of insulation resistance in such cables in the ratio of one to three.

Extra-high-tension Rubber Cables.—The specifications issued by engineers for extra-high-tension rubber cables, usually state the proportion of Para rubber which the vulcanised rubber shall contain, the pressure test to which the cable shall be subjected in water (usually two or three times the working pressure), the insulation resistance per mile, and sometimes the radial thickness of the dielectric. Much greater care is necessary in making extra-high-tension cables than in ordinary low-tension cables, because the working conditions have a tendency to create effects (such as electrolytic dissociation in the dielectric, and static discharge from the outer coverings of the cable and the consequent ozonising effect) which are almost negligible at ordinary low pressures.

The former depends to a very great extent on the treatment of the rubber, and the selection and preparation of the loading materials which are used in conjunction with it.

The latter may be avoided to a very great extent by metallic braiding or lead covering. Otherwise there is always risk of a

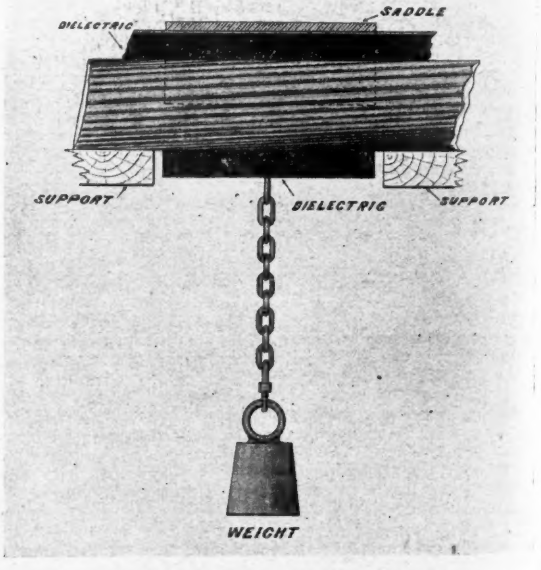


FIG. 2.—DECENTRALISATION TEST.

static discharge occurring from the usual fibrous outer coverings at local places, which afford convenient paths for the same, and which may cause local oxidation of the rubber, and ultimately a breakdown.

Fire-Resisting Cables.—Fire-resisting coverings are usually applied to "Rubber Cables," for the simple reason that rubber cables are chiefly used in situations where measures for the prevention of fires are most required. However, they may be just as efficiently applied to other types of insulation, such as V.B. or G.P., where the volatilisation of the combustible constituents would cause fire to spread rapidly.

The fire resisting properties cannot practically be secured through any modification of the dielectric, and must be attained by special treatment of the tapes, braidings, or lappings which form the usual mechanical protection to such cables. These fibrous materials may be chemically treated, so as to be absolutely incapable of supporting flame, and this treatment (under the process devised by one of us, used by Messrs. W. T. Glover & Co., Ltd.), is preferable, and for the sake of efficiency is applied to the yarns or fabrics before applying them to the cable.

Tanned jute is found to be the most suitable fibrous material for this purpose (though cotton, hemp, or flax may be used), and has at the same time the advantage of being mechanically strong, and therefore not liable (as asbestos is) to succumb to vibration or rough handling.

During and after the process of lapping, braiding, &c., a suitable fire-resisting compound is served on to the coverings. Any degree of fire-proofness can be attained by adding to the number of braidings or lappings. In practice, these are proportioned to the volume of inflammable material (*i.e.*, dielectric proper) in the cable, to the sizes of the cable, and to the particular class of work for which the cable is intended.

Imagine such a cable to be subject to the heat of a fierce flame externally for a prolonged period. After a lapse of time, dependent on the proportion of fire resisting coverings to volatilisable materials (dielectric), the latter becomes softened by the heat, and ultimately decomposes and assumes the gaseous state. When the gases thus formed have accumulated sufficient pressure inside the cable, they force their way through the fire resisting coverings, and burn on the exterior of the cable. But when the cause of the volatilisation is taken away (*i.e.*, the external flame), the flame on the cable quickly disappears, and does not spread along the cable, as would be the case if the ordinary preservative compounds were used.

In the same way, if the source of heat applied to the cable is internal (an arc due to a breakdown of the dielectric, for instance), volatilisation will proceed at the point of breakdown so long as the arc is kept up, but the resultant flame will disappear almost immediately the arc is stopped, because there is nothing on which the flame can feed.

Moreover, the flame due to the combustion of the volatilisation products is not hot enough to ignite any adjacent cable having similar coverings, so that in every way the fire-resisting coverings tend to keep flame, arising from any cause, purely local.

Dielectric from cable.	Specific gravity.	Ash.	Saponifiable matter.	Unsaponifiable matter (org.).	Total sulphur.
A	1·076	7%	76·2%	12·7%	4%
B	1·31	34·7%	18·0%	45·1%	2·1%
C	1·15	18·27%	30·0%	47·5%	4·2%

Consider for a moment the behaviour of an ordinary cable under similar circumstances. The preservative compounds burn readily, and the flame will rapidly travel along the exterior of the cable, thus continuously and increasingly causing the volatisation of the dielectric, the gases from which add considerably to the conflagration. Contrary to the case of the fire resisting cable, the flames due to the preservative compound alone will readily ignite a similarly served adjacent cable.

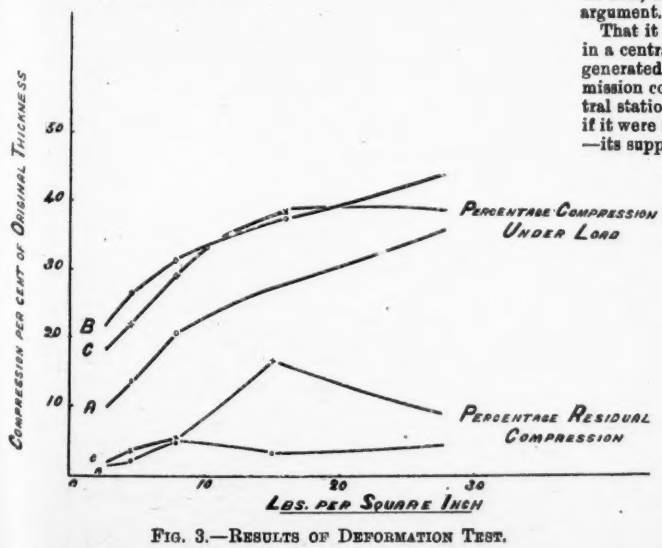


Fig. 3.—Results of Deformation Test.

Vulcanised Bitumen Cables.—The early bitumen cables consisted of a wire coated with pure bitumen, but these cables were found to decentralise with more or less rapidity. Later, a cable was introduced by Messrs. Callender's Cable Co., under the name of "Vulcanised Bitumen," insulated with a material produced by sulphurising a product of the distillation of certain oils, which has been very extensively used, and which alone or with other compounds forms the basis of several well-known insulating compounds.

The properties of some such cables may be considered by taking three examples of cables made by well-known cable making firms, which will be referred to as A, B and C, of which the compositions were shown in the table in the previous column.

In order to find out how this class of cable behaves under various circumstances, a series of experiments were carried out by Mr. Bertram Blount, F.I.C., at his laboratories in London, after consultation with the authors, and an examination of the lines of research carried out by one of them. The results are here incorporated.

In order to determine the tendency to decentralise in cables of this class, particularly at a moderately high temperature, short lengths of cable were loaded, the bare ends of the conductor being supported. The load was carried by a saddle across the cable, equivalent to 1 lb. per lineal inch of cable as shown in fig. 2.

The following table (2) shows the amount of decentralisation which occurred after six hours in an air-bath at a temperature of 90° C. = 194° F.

Specimen.	Size of cable.	Before test. Thickness of dielectric.	After test.	
			Thickness. Upper side.	Thickness. Lower side.
A	Not tested	—	—	—
B	19/16	·121	·115	·12
C	19/16	·125	·12	·13

To determine more exactly the action of such compounds under load, bearing in mind that considerable weights of cable are often supported in a manner which concentrates the weight at one point, experiments were carried out to measure the deformation of samples of the material under definite loads, and the results are shown in fig. 3. The upper lines show the percentage compression of the samples A, B and C under the various loads given by the abscissæ. The lower lines show for the same loads the residual deformation on removal of the load.

Sample B buckled when the load was removed, hence the permanent distortion could not be measured. These results show that with loads capable of very largely compressing the material, the elasticity is good; but they point out that with such materials some care must be exercised, by judicious design of methods of support, to avoid the localising of supporting and other stresses.

(*To be concluded.*)

THE VALUE OF OVERHEAD MAINS FOR ELECTRIC DISTRIBUTION IN THE UNITED KINGDOM.

By G. L. Addenbrooke, Member.

(*Abstract of Paper read in London, February 9th*, 1905.)

The electric transmission of power on a large scale has been carried out chiefly in districts in Europe and America where abundant water power was available and the cost of coal was considerable. Taking the conditions met with in Britain, it is my view that in nearly all cases it will pay better to locate the central station near to what may be called the "power centre of gravity" of the district to be served, and bring the coal to it, rather than to place the central station at a greater distance from its work in order to save freight on coal, and progress is likely to accentuate the soundness of this argument.

That it is cheaper to generate power from coal on a large scale and in a central station, than when the same total amount of power is generated by scattered units, has become almost an axiom. If transmission cost nothing it would be sufficient to set down such a central station in any suitable district, and within a moderate period—if it were not over-capitalised and were economically administered—its supply would displace all other sources of power in the district. But transmission costs money and involves losses, and consequently there arises the important engineering problem of how to make this capital cost and loss a minimum.

For many reasons the costs of generating the energy and the costs of distribution between the power-house and the terminals of the consumers' motors should be kept as low as possible.

All that it is necessary to say here is that to secure good results the greater the amount of power which can be supplied from a given station the better, and also the better the load-factor, the lower the average price which can be charged.

It should be in a position to invite customers from as large an area as possible, because it is not likely that manufacturers within range of the mains will change over the whole of the arrangements in their establishments to electric driving immediately; they will usually commence by adopting electric driving tentatively for some particular purpose, and gradually extend as they find it convenient and economical and can afford to make the change. Moreover, power companies should not be compelled to confine their operations during their earlier years to the richest corners of their districts.

In considering systems of overhead transmission in the United Kingdom, it becomes of practical importance to see how they compare with underground transmission, and what difference their employment may make in the policy and procedure of power companies. For this purpose I have had prepared two tables showing approximately the cost of overhead conductors and under-

ground mains employed under similar conditions. The costs in both cases are for high-class work, and this applies particularly to overhead work, as it is the experience of users both on the Continent and in America that to secure the best results such work must be solidly and carefully constructed, and with due consideration of the requirements to be met.

not hear of any legislative prohibitions of this method of transmitting energy; there are no signs that overhead conductors are being given up; on the contrary, every week we hear of fresh projects.

The leading firms on the Continent stated that, so far as the general public was concerned, they could not recall any accident,

Overhead Mains.—Three-Phase Cables. On the Basis of 1 per Cent. Loss per Mile.

Particulars of the conductors			Carrying capacity in kilowatts at the following voltages.				Capital cost of line complete per mile, allowing 45 poles per mile at the following voltages.				Capital cost of line complete per kilowatt conveyed per mile at the following voltages.			
Size of cables.	Section of cables in square inches.	Weight per mile in lb.	6,000.	8,000.	10,000.	12,000.	6,000.	8,000.	10,000.	12,000.	6,000.	8,000.	10,000.	12,000.
3— 7/18	·01292	3 × 266	81	152	225	323	£211	£230	£245	£260	52/-	30/-	22/-	16/-
3— 7/16	·02299	3 × 468	143	254	400	545	£ 59	£275	£290	£305	36/3	21/8	14/6	11/3
3— 7/14	·03588	3 × 730	222	394	615	887	£301	£316	£332	£347	27/-	16/-	10/9	7/10
3—19/16	·06247	3 × 1,270	382	680	1,060	1,526	£402	£418	£433	£448	21/-	12/4	8/2	5/10

Underground Mains—Three Phase Cables.—On the Basis of 1 per Cent. Loss per Mile.

Particulars of the conductors.			Carrying capacity in kilowatts at the following voltages.				Cost of main complete per mile laid and jointed at the following voltages.				Cost of line complete per kilowatt conveyed per mile at the following voltages.			
Size of cables.	Section of cables in square inches.	Weight per mile in lb.	6,000.	8,000.	10,000	12,000.	6,000.	8,000.	10,000.	12,000.	6,000.	8,000.	10,000.	12,000.
3—7/18	·01292	3 × 266	81	152	225	323	£490	£540	£678	£80(	120/	71/-	60/-	49/6
3—7/16	·02299	3 × 468	143	254	400	545	£520	£653	£725	£87(	73/-	50/-	36/-	32/-
3—7/14	·03588	3 × 730	222	394	615	887	£545	£560	£772	£95(	49/-	34/-	25/-	21/-
3—19/16	·06247	3 × 1 270	382	680	1,06)	1,5?6	£760	£858	£957	£1,15(	40/	25/-	18/-	13/3

I may say that, in the costs for the overhead transmission, a fair sum is included for extra poles and networks when crossing roads or places to which the public have access.

In these tables the costs of overhead conductors have been calculated on the basis of a single set of conductors of the sizes mentioned, on a pole, but when more power is wanted, a second set of conductors can usually be added at the cost of copper, insulators, arms, and erection only, whereas to lay a second cable will cost practically as large a sum as the first. Herein lies one of the great advantages of overhead distribution; the current can be taken to a works and a small-sized set of conductors put up to commence with, at half the capital outlay required for laying a cable of similar section. If the use of electric energy should afterwards be discontinued for any reason, the poles and wires can be recovered, and are still worth a great part of the original value, as they can be used elsewhere. If, as is probable, the use of current is extended, another set of larger conductors can easily and cheaply be erected. With a cable, if an underground main is discontinued, it is worth nothing to take up. To lay a full section cable in the first instance means locking up a great deal of capital unremuneratively, possibly for some years; on the other hand, to lay a small cable first and a second larger one later is very expensive. In the first case—viz., with overhead conductors—the capital required will only be half that required in the second, and, moreover, a good proportion of it will remain in a liquid form. Thus, by employing overhead conductors, a power company is sinking a much smaller amount of capital in extending its mains widely during its early stages.

Besides the lower cost per mile of the distributing system with overhead mains, which in many cases would make the difference whether a supply can be given profitably or not, it is important to observe also that if it will pay to carry the current a certain distance by underground mains, it will pay to carry the current nearly twice as far with overhead conductors, which means that a power station can economically supply current over about three times the area which would be possible with underground transmission at 6,000 volts, and if the pressure is increased, the relative areas show a still greater difference. For this reason, not only has a power station with overhead transmission a much larger area from which it can pick up customers and thus acquire a load quickly, but it will later on have a larger area to draw customers from, so that the advantages of additional size and concentration are also secured in a greater degree.

It is also important to bear in mind that overhead conductors are, comparatively speaking, free from the complicated phenomena known as resonance effects, which give a good deal of trouble on underground circuits and have been a cause of much anxiety.

In Mr. Bell's book on "Power Transmission" there is a list of power transmission plants in America all at pressures above 10,000 volts, the list apparently being carried up to the year 1901, and probably at the present date there must be in America over 500,000 h.p. transmitted electrically by overhead conductors. Notwithstanding this, we come across no long lists of accidents; we do though they could usually mention one or two cases of accidents to employés—almost invariably, however, from transgressing simple rules as to not working on circuits with the pressure on.

A little thought will show that with a properly-constructed route of overhead mains, with stout poles 40 to 50 yards apart, the chances of the mains falling are infinitesimal, far less than in the case of telegraph wires, which are much smaller in diameter, and are run habitually in spans double the length; and the mains are strained up much less tightly than in the case of tramway conductors.

The most legitimate objection is from the æsthetic point of view, but against this should be placed to their credit the fact that they would be the means of abolishing much smoke and dirt and heavy coal traffic on the roadways.

Abroad, overhead power-transmission mains freely traverse much of the finest scenery, and yet tourists and others do not find them overpoweringly objectionable. Overhead power mains are not more unsightly than heavy telephone or telegraph transmissions, which we already have with us on a large scale, and as they would more often traverse the open country, they would be still less in evidence. A great deal can also be done to remove their obtrusiveness by simply painting the creosoted poles green or grey.

We now come to the third objection to overhead transmissions, namely, that they are liable to faults. The fact that towns like Rome, Berne, Milan and Buffalo are, and have been for several years, dependent on electrical energy supplied over distances of from 15 to 30 miles by overhead mains, is clear proof of their reliability when well erected and looked after. It is a point in favour of overhead transmissions that any fault which may occur can be so easily located and quickly remedied. The risks of wilful damage are much less than is supposed, as to do effective damage without personal risk requires an elaboration of means and an amount of knowledge which is possessed by few.

The real danger of interference with overhead transmission is from lightning; but overhead transmissions are freely used now in countries where thunderstorms are so much more frequent than in this country, that I do not think we need have any fear under this head in the United Kingdom, when proper precautions are taken.

We are now brought to the consideration of what is the practical position, supposing transmission of this character is proposed in this country.

The Board of Trade have passed a series of routes in a case in which the writer is acting as engineer, which go as far in these respects as I think engineers can reasonably ask for at the present stage. The Board, however, still appear to have objections to high-pressure transmissions being erected along the sides of roads. Consequently, as things stand at present, wayleaves will usually have to be obtained for carrying the mains across the neighbouring fields.

In choosing a line of route, it is very desirable that it should be within sight of roads or good footpaths, in order that the line may be inspected easily.

It would be a great facility if there were in this country a set of laws and regulations, such as have been made in several foreign

countries, giving undertakers the power to obtain such wayleaves by a form of compulsory arbitration, when it can be shown that the project is of public utility.

In this country such powers can at present only be obtained by a specific Act of Parliament, which is far too cumbrous and expensive a method of procedure, and is, moreover, impracticable, since it is only as a project develops that the routes of a great part of the mains can be definitely settled.

To show the arrangements and formalities necessary to obtain such rights, a translation of the Swiss and Italian laws relating to electric transmission is appended to this paper.

So far, I have dealt chiefly with the branch of the overhead distribution problem which for the moment concerns us most directly, but there is another aspect of it of nearly equal importance to which I will now allude—I mean the distribution of electrical energy at voltages suitable for lighting, running motors, heating, and other direct uses.

From recently published statistics we find that in the United States, out of a total of 125,000 miles of feeding and distributing networks, 117,000, or 93 per cent of the whole, are overhead, there being in all the United States only 8,124 miles of underground circuits.

There is no reason why, with overhead distribution and a cheap system of wiring, such as is in use everywhere except in this country, all the smaller centres of population and the outskirts of the larger towns should not enjoy the benefits of electric light and power supply, which they are hardly likely to do for another 20 years without this system of distribution.

It is, further, worth pointing out that most of the local distribution abroad is at 110 volts. With 240 volts, such as we use largely here, the problems involved are much simpler, greater areas can be covered, and the sections of copper required lend themselves very well to being carried overhead.

Before closing, I should like to say a few words on another class of overhead electric distribution which is fast attaining an important place, namely, distribution at very high pressures such as 50,000 volts. When electric distribution is effected at these voltages, not only do we get into a new order of phenomena electrically, but economically also. The capital cost of the line comes down to from 1s. 6d. to 2s. per kilowatt conveyed per mile, with a loss of, say, ½ of one per cent. per mile. From what I have seen in the Colonies I feel sure that such long-distance transmission lines will be of great value there and in India, and will open up many possibilities. The opportunities for advantageously employing them will probably not be many in this country, except, perhaps, in connection with railway work, but it is very desirable that every facility should be given for their erection wherever they would be clearly advantageous, for the sake of the practical example they would offer, and the experience which would be gained in operating them on the spot.

Some time ago, the Committee of the American Institute of Electrical Engineers appointed a Commission to inquire into the practice with regard to high-pressure transmission. This body issued a pamphlet, which covers the whole field of high-pressure overhead transmission, and gives the views and recommendations of experienced men on almost every point, including poles, arms, spans, conductors, insulators, leading in, effect on other conductors, lightning arresters, and numerous other practical points.

An Appendix to the paper contains translations of the Italian and Swiss laws relating to electrical transmission lines.

The former require proprietors of land to permit the crossing of the same by either overhead or underground conductors, for either permanent or temporary industrial purposes, with one or two minor exemptions. This also applies to canals, aqueducts and similar works.

The special laws applying in such cases must be observed when crossing public streets, or rivers, or streams, or where touching the exteriors of houses facing streets and squares. Other clauses relate to the necessity of eliminating danger, of proving ability to erect and value for industrial purposes; indemnities, compensation and disputes are also treated.

Rules for putting into effect these laws are appended, including the following special rules:—

(*a*) For railways and for tramways on their own ground, in which it is stated that where possible conductors should not be laid along railways, nor on railway land or premises.

(*b*) For public roads away from dwellings, for rivers, streams and canals; in which case, where telegraphic or telephonic lines for public service exist or will have to be placed, the installation of electrical conductors is absolutely prohibited, although this can be modified by arrangement with the Minister of Posts and Telegraphs.

(*c*) For public streets and squares, which deals with the interpretation of the rights and responsibilities of wayleaves.

The Swiss Federal law gives the Federal Council the right to grant powers of expropriation to the owners of electrical undertakings, as also to the consumers.

This applies to private property, railways, the public lands and highways of the communes, but in the latter case refusal or restriction is allowed except when the energy is required for the electrical working of a railway.

Further clauses relate to indemnities, to the method of procedure in applying for powers, &c.

VISIT TO SHIPLEY.

The Leeds Section visited the electric light and power works of the Shipley Urban District Council on Saturday last, being conveyed to and from Bradford by special car, by the courtesy of the Bradford Corporation. The party was met by Mr. Lindley, chairman of the Electricity Committee, and Mr. Schofield, the resident engineer.

After inspecting the works, the party returned to the Talbot Hotel, Bradford, where tea was served, after which a meeting was held, the President of the Section, Mr. Walter Emmott, being in the chair. The various details of the design and equipment of the Shipley works were discussed, especially in regard to steam consumption, working costs, &c., and full details were given by Mr. Schofield.

The sewage pumping and outfall works, refuse destructor, and electricity supply works for lighting and tramways are all on the same site. The boiler-house equipment includes four Lancashire boilers, one of which is worked in conjunction with the refuse destructor. Two "Meldrum" mechanical stokers of the "Sprinkler" type are installed. Superheaters of the Bolton type are fixed in the downtakes behind the boilers, and a Green economiser of 192 tubes is installed. The generating plant consists of four Parsons turbines, direct coupled to three 240-kw. and one 400-kw. compound-wound dynamos. Two surface condensing plants, each capable of dealing with 10,000 lb of steam per hour, are installed. The accumulators consist of 260 Tudor cells, the normal output being 750 ampere-hours, and the maximum discharge rate 250 amperes. A 50-kw. traction motor, coupled to two 25-kw. lighting generators, is used for supplying lighting current from the traction side, or *vice versâ*, and also as an ordinary balancer; and a reversible battery booster is provided.

During the nine months ending December 31st last, the units generated were 985,988, of which 401,300 were sold for traction, and 310,300 to private consumers.

The tramways, which have a length of six route miles, are the property of the Council, but are leased to the Bradford City tramways department. The gauge is 4 ft.

The destructor is of the Meldrum regenerative type, and is worked in conjunction with a 30 ft. × 8 ft. Lancashire boiler. The maximum capacity of the destructor, with average ashpit refuse, is 50 to 55 tons per 24 hours. The average daily supply is 25 tons.

The whole of the sewage of the Shipley district is dealt with at these works. Nine-tenths of the sewage is lifted 47 ft. by electrically-driven sewage pumps consisting of two Gwynne centrifugal pumps direct coupled to 60-h.p. and 30-h.p. compound motors respectively.

The late Mr. R. C. Quin was responsible for the original installation of the plant. Later extensions have been carried out by the present resident engineer.

PAOLO CASTELLI.

The decease of Paolo Castelli, the inventor of the Castelli coherer with which Signor Marconi, then in Newfoundland, first succeeded in receiving signals (the letter S thrice repeated) across the Atlantic, is announced by the Italian journal *Il Tempo*, of Milan, in a sympathetic notice of his work by Signor Masiero. From that notice we extract the following notes:—

The royal Italian marine, immediately after the early successes of Signor Marconi over short distances, initiated its first experiments with the consent and aid of the inventor. Prof. Pasqualini and Captain Bonomo undertook at divers times, now on land and now on the sea, now in the Gulf of Spezia and now on the shore from Spezia to Leghorn, a series of tests, the results of which did not seem as satisfactory as it appeared that they ought to have been according to the earlier experiments of Marconi.

During his period of experimenting, Captain Bonomo was assisted by Corporal Paolo Castelli, a semaphore telegraphist of the royal marine, who, being charged with a passive *rôle* such as is the handling of the key for signalling, was able, with the insight of a studious and ingenious youth, to discover what might be the weak side of the transmission, and succeeded in producing the coherer that bears his name. It was due to this apparatus that the tests initiated by our (Italian) military marine gave the results which brought honour to all. The proof of this is afforded by what Captain Bonomo said of them in his report to the Minister of Marine.

"Toward the end of January of this year (1901)"—wrote Bonomo—"the insistence of the petty officer, Paolo Castelli, induced me to experiment earlier" (than the completion of the earlier experiments) "on the system of receiving by telephone" (instead of the relay and Morse apparatus patented by Marconi).

"The sensibility of telephonic reception being such as to exclude the use of ordinary coherers, it would have been necessary to recur to those having automatically decohering tubes with carbon powder, when Castelli invented the use of a tube with electrodes of carbon containing two drops of

mercury separated by a little cylinder of iron. Although this tube was roughly constructed by him, yet the results were surprising, and on Wednesday, February 20th, 1901, not only was he able to receive the transmission from Palmaria, but he was able also to distinguish clearly the rhythm of the oscillator of that station in such a way that he was able to count the component sparks.

"The result was most excellent, and the tubes invented by Castelli, having electrodes of iron or carbon with one or more drops of mercury, besides presenting an extreme sensibility, rapidly decohered of themselves."

These words ought to be inscribed upon the modest cross which will mark the spot where lies the inanimate body, once so robust, of this youth of genius in whom the force of will and a firm love of study took the place of academic qualifications.

The invention of his coherer was, however, for Castelli only the beginning of his torments. He failed to remember that he was no longer part of the free world; that the man must be subordinated to the soldier. He forgot the fate of that companion-in-arms of his, who, having invented an apparatus useful in the marine, and having requested a suitable reward, in view also of offers which he had had from private parties, found himself answered that "an Italian, when he is in the army, gives to his Fatherland his whole intelligence with his whole powers," and in the end, as encouragement, received a hundred francs. He had the simplicity to believe that he was in a position to make his rights of value, and thereupon began a pitiless and implacable war of the big-wigs against the poor corporal.

To Prof. Banti, who asked him, in 1902, for some notes upon the invention of his tube, Castelli answered with, amongst others, these words, which reveal the outrage which from that time tortured his soul:—

"I can tell you nothing: in charity do not occupy yourself with my personal affairs, because you will get only harm from them." That is how the petty world of the Italian military, shut within the circle of frivolous ambitions, of bedizened uniforms, dreaming of promotion to higher rank, treated the obscure petty officer of marine, who seemed likely to emerge above the heads of officers panting for an approving smile, or a congratulatory note from Marconi. And the life of these three years was for Castelli a period of intellectual compression, intended to choke in his mind every germ and every initiative that would make him known outside the circle of his few friends.

It does not rest with me (writes Signor Masiero) to determine whether the coherer of poor Castelli has or has not been actually adopted in wireless telegraphy. What cannot be denied is that his invention brought about a great step in the system of Marconi, since, with other scientists, the latter had for a long time striven to find a sensitive coherer of certain action. In fact, in September of the same year, 1901—that is, eight months after Castelli had experimented with his tube—Guglielmo Marconi himself patented* in London one very little different.

Poor Castelli never recovered from the blow of fortune, and after a visit to China he returned to die at home of an incurable disease.

The obituary notice in the *Elettricista* well says: "His end is characteristic of his life; in his death he was a victim to his military duty, as in his life he was a victim to his genius."

Theatre Dimmers.—We learn from Messrs. Geipel and Lange that the proprietors of the New York Hippodrome have recently ordered 124 100-light Ward-Leonard dimmer plates, which are to control no fewer than 12,400 60-watt lamps. The dimmers are of the well-known Ward-Leonard type, in which all the resistance material is embedded in porcelain enamel, attached to cast-iron plates. The feature of this apparatus is that there is a large number of contacts, and the construction is entirely incombustible, owing to there being no inflammable material used throughout. This is believed to be the largest order of the kind yet placed in the hands of one firm.

* This patent, it will be remembered, Signor Marconi, on being challenged as to his right to the invention, changed, by a formal document in the Patent Office, into a patent communicated to him by a certain Italian Marquis! The thing was officially announced in the *Journal* of the Patent Office for July 16th, 1902.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

2,263. "Electric working of mine-shafts." J. SWINBURNE. February 6th.

2,299. "Improvements in and relating to electroliers and electric wall-brackets." G. SHILVOCK. February 6th.

2,313. "Electrical dental furnace." L. LAWRENCE BOSWORTH. February 6th. (Complete.)

2,328. "Improvements in apparatus for heating water electrically." M. H. SHOENBERG. February 6th. (Complete.)

2,339. "Improvements in electric machines." W. A. JOHNSON. February 6th. (Complete.)

2,341. "Improvements in brush-rocking gear for dynamos." H. LEITNER and H. HILL. February 6th.

2,342. "Improvements in electric lighting of trains." H. LEITNER and R. N. LUCAS. February 6th.

2,351. "Improvements relating to apparatus for telegraphic purposes." J. T. SZEK. February 6th.

2,387. "Improvements in electrical switches." J. A. K. MCGREGOR. February 7th.

2,426. "Improvements in electrical resistances." H. W. LEONARD. February 7th.

2,432. "Improvements in electric systems." H. DOWIE. February 7th. (Complete.)

2,401. "Improvements relating to the starting and control of direct-current electric motors." W. H. HEATH. February 7th.

2,474. "A new or improved process for neutralising static electricity." W. H. CHAPMAN. February 7th. (Complete.)

2,475. "Improvements in automatic systems of signalling for electric railways." S. M. YOUNG. February 7th. (Complete.)

2,490. "Improvements in methods of insulating the windings of dynamo-electric machines." THE BRITISH THOMSON-HOUSTON CO., LTD., and S. VAN AMMON. February 7th.

2,491. "Improvements in thermal cut-outs or fuses." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) February 7th.

2,506. "Improvements in or relating to the trolley pulleys of electric tramcars." J. N. HICKS and M. GALVIN. February 8th.

2,523. "Improvements in electric stop-motions for drawing, slubbing, intermediate roving and like frames." E. TWEEDALE and S. TWEEDALE. February 8th.

2,545 "Improvements in the electrical regulation of clocks." F. A. CHANDLER and B. BONNIKSEN. February 8th.

2,554. "Improvements in or relating to electrical connections." P. HALLOT. February 8th. (Complete.)

2,559. "Improvements relating to electric ignition apparatus." SIR O. J. LODGE and A. M. LODGE. February 8th.

2,579. "An improved protector or casing for electric conductors or the like." O. WILHELMI. February 8th. (Complete.)

2,581. "Improvements in homopolar dynamos." H. LEITNER. February 8th.

2,586. "Improvements in electric switches." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) February 8th.

2,607. "Improvements in fusible cut-outs." H. H. BERRY and S. M. G. TEAL. February 9th.

2,628. "Improvements in electric ignition arrangements for explosion motors." A. SCHOELLER. February 9th. (Complete.)

2,631. "Improvements in ships' telegraphs." J. D. LYNCH. February 9th.

2,632. "Improvements in or relating to burnishing tools for use in the electro-deposition of metals." J. C. JOBLING and H. C. HARRISON. February 9th. (Complete.)

2,639. "Improvements in electrical lampholders." E. B. BOTCHER. February 9th.

2,658. "Electric lighter." A. C. CANN. February 9th.

2,673. "Improvements in apparatus for the periodic making and breaking of an electric circuit suitable for use in connection with electric lamps and other electric apparatus, horological instruments and for other purposes." G. C. FRICKER. February 9th.

2,691. "Improvements in electric signalling systems and apparatus therefor." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) February 9th.

2,692. "Improvements in and relating to electric arc lamps." E. R. GROTE and M. V. ELY, trading as Foster & Co. February 9th.

2,693. "Trolley-pole controller." S. E. GUNYON. (The Magney Manufacturing Co., United States.) February 9th. (Complete.)

2,715. "Improvements in connection with pendants, brackets, and the like fittings for gas, oil and electric lighting, and for similar purposes." A. W. SOUTHGATE and F. SOUTHGATE. February 10th.

2,728. "A new and improved system of running and insulating electrical conductors." A. S. MARTIN and G. V. STAVERT. February 10th.

2,742. "New or improved apparatus for distributing electric currents or producing electric pulsations." A. T. M. THOMSON and G. O. ELLIS. February 10th.

2,747. "Improvements in electric cables." C. J. BEAVER and E. A. CLAREMONT. February 10th.

2,749. "Time element maximum current thermal device for cut-outs, alarms, or indicators." F. BILIOTTI. February 10th.

2,766. "Improvements in locks and switches for gates of electrically controlled lifts." C. G. MAJOR, E. C. STEVENS and P. H. STEVENS. February 10th.

2,777. "Improvements in the construction of electric belts, bands and other wearing devices." J. W. FOWLER. February 10th. (Complete.)

2,789. "Improvements in protective devices for electric circuits." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) February 10th.

2,850. "Improvements in connection with electrostatic watt and watt-hour meters." E. WILSON and W. H. WILSON. February 11th.

2,862. "Improvements in protective devices for electric apparatus." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) February 11th.

2,864. "Improvements in installations for controlling electrically-propelled trains." SIEMENS BROS. & Co., LTD., and C. F. JENKIN. February 11th. (Complete.)

2,871. "Improvements in or relating to hermetically enclosed arc lamps, such as are known as electric vapour lamps, partly applicable to other electrical purposes." C. O. BASTIAN and G. CALVERT. February 11th.